M.Sc. ZOOLOGY

(Choice Based Credit System)

For the students admitted in the academic year 2021- 2022

DEPARTMENT OF ZOOLOGY

Bishop Heber College (Autonomous)
(Nationally Reaccredited at the A+ level by NAAC)
(Reaccredited with 'A' Grade (CGPA – 3.58/4.0) by the NAAC &
Identified as College of Excellence by the UGC)

TIRUCHIRAPPALLI – 620017

TAMIL NADU, INDIA

PG and Research Department of Zoology
Bishop Heber College (Autonomous)

Vision

Envisage quality higher education and research in the field of animal sciences with global perspectives by promoting discovery and learning contemporary fields in Zoology inculcating social values for the holistic development and to conserve nature thus contributing for nation building.

+

Mission

- **Bestow quality education emphasizing the cognitive learning and concern towards the animal kingdom.**
- **Promulgate biodiversity conservation, field training skills, and entrepreneurship in the applied zoological sciences**
- **Enhance highest level of academic accomplishment with interdisciplinary approach through research, industrial collaboration and amalgamate with reputed national and international universities**
- **Foster globally competent individuals with interpersonal skills and environmental consciousness for the betterment of the world.**

Programme Outcomes – PG – Zoology

On successful completion of the programme the Post graduant of Zoology

will be able to

Knowledge

PO1 - Comprehend and apply accurately and creatively the principles and applications from the core areas in Zoology and its allied field.

PO2 - Develop a holistic approach on the phylogeny with the rich diversity of organisms and their adaptations in ecology and evolutionary significance

PO3-Exhibit academic excellence in research and intellect in the areas of advanced Biological Research and Biodiversity Conservation

Skills

PO4 - Formulate an appropriate solution for complex research problem and publishing the new findings in innovative research

PO5 –Demonstrate ddiversified professional proficiency gained through various laboratory technical training, field census, internships, industrial and research projects.

PO6 –Exhibit transferable and entrepreneurial skills in collaboration with research institutes and undertake interdisciplinary research.

Attitudes

PO7 - Build trust and blend complementary strengths through communicative competence, encourage healthy risk-taking, and promote wider sense of ownership.

Ethical & Social Values

PO8-Exhibit ethical and social values commit to professional ethics, liability and widen the empathy and love towards the animals

PO9 - Develop methods towards protection of endangered species, pollution control, waste management and pave way for a sustainable environment.

Programme Specific Outcomes

Knowledge and Skills

PSO1-Illustrate the comprehensive knowledge of origin, salient features and functional aspects in system grade of organizations from lower invertebrates to higher chordates

PSO2 -Comprehend the functions of organisms at the level of gene, genome, cell, tissue, organ and development, reproduction and behaviour of different lifeforms and their interrelationships with the environment.

PSO3-Analyze the biochemical, microbiological, Immunological processes and Bioinformatics ddatabases to track evolution and predictions of biomolecules and to test the hypothesis by using statistical tools

PSO4- Identify appropriate resources like animal handling techniques and model organisms required to carry out the projects and apply the technical skills to contribute new scientific discoveries and inventions.

Post – Graduate Programme in Zoology

Structure of the Curriculum

Parts of the Curriculum	**No. of Courses**	**Credits**
Core Course (Theory)	10	50
Core Course (Practical)	5	15
Elective	5	18
Project	1	5
VLOC	1	2
-Total	**22**	**90**

M.Sc., Zoology
(For the candidates admitted in the academic year 2021 onwards)

Sem.	Course	Course Code	Course Title	Pre requisites	Hours Per Week	Credits	Marks		
							CIA	ESA	Total
I	Core I	P19ZY101	Functional Morphology of Invertebrates and Chordates		5	5	25	75	100
	Core II	P19ZY102	Cell Biology		5	5	25	75	100
	Core III	P19ZY103	Molecular Biology and Bioinformatics	P19ZY102	5	5	25	75	100
	Core Prac. I	P21ZY1P1	Lab in cell biology and Molecular Biology		5	3	40	60	100
	Core Prac. II	P19ZY1P2	Lab in Microbiology/parasitology		5	3	40	60	100
	Elective I	P20ZY1:1/ P19ZY1:A	Microbiology/Parasitology	P19ZY101	5	4	25	75	100
II	Core IV	P20ZY204	Animal Physiology	P19ZY101	5	5	25	75	100
	Core V	P19ZY205	Biochemistry	P19ZY102	5	5	25	75	100
	Core Prac. III	P19ZY2P3	Lab in animal physiology and Immunology/endocrinology		5	3	40	60	100
	Core Prac. IV	P19ZY2P4	Lab in Biochemistry		5	3	40	60	100
	Elective II	P19ZY2:2/ P19ZY2:A	Immunology/Endocrinology		4	4	25	75	100

	Elective III	P19ZY2:3	Biostatistics		4	2	25/ 40	75/ 60	100
	VLOC	P17VL2:1 / P17VL2:2	RI / MI		2	2	25	75	100
III	Core VI	P19ZY306	Environmental Biology		5	5	25	75	100
	Core VII	P19ZY307	Developmental Biology	P19ZY101	5	5	25	75	100
	Core VIII	P19ZY308	Genetics		5	4	25	75	100
	Core IX	P19ZY309	Research Methodology and Biotechniques		5	4	25	75	100
	Core Prac. V	P19ZY3P5	Lab in environmental biology, Developmental biology and Genetics		6	4	40	60	100
	Elective IV	P19ZY3:4/ P19ZY3:A	Animal Biotechnology/ Genomics and Proteomics	P19ZY1:1	4	4	25	75	100
IV	Core X	P19ZY410	Evolution and Animal Behaviour		5	4	25	75	100
	Elective V	P19ZY4:5/ P19ZY4:A	Applied Entomology/ Bioinformatics	P19ZY 101	5	4	25	75	100
	Project	P19ZY4PJ	Project		--	5	--	--	100
Total						**90**			**2200**

CI A- Continuous Internal Assessment
ESA- End Semester Assessment **VLOC- Value added Life Oriented Course**

CORE – I : FUNCTIONAL MORPHOLOGY OF INVERTEBRATES AND CHORDATES

SEMESTER: I **COURSE CODE: P19ZY101**
CREDITS: 5 **HOURS/WEEK: 5**

1. COURSE OUTCOMES:
On completion of the course, the students will be able to :

CO NO.	COURSE OUTCOME	Level	Unit
CO1	Identify the basics of systematics and compare the hierarchy of various animals	K3	I
CO2	Analyze the diversity in structure, function and habits of invertebrates	K4	I
CO3	Explain the diagnostic characters of different phyla through detailed studies of the various systems and organizations with examples	K5	II
CO4	Identify the evolutionary significance of the lower order invertebrates by comparing their larval forms	K3	III
CO5	Classify the morphological and functional characters of Chordates	K4	IV
CO6	Explain the structure and functions of integumentary system and compare the anatomy of nervous and urino-genital system	K5	V

2. A.SYLLABUS

UNIT I: **CLASSIFICATION OF ANIMAL KINGDOM** **(15hrs)**

Broad classification of Animal kingdom - International code of Zoological nomenclature – Symmetry and its significance in animal organization - **Organization of coelom**: Acoelomates - Pseudocoelomates – Coelomate groups (schizocoel, enterocoel, and mesenchyme). **Locomotion**:Amoeboid, flagellar and ciliary movement in Protozoa**–** **Hydrostatic movement in Coelenterata and Echinodermata.**

UNIT II: DIGESTION, RESPIRATION AND EXCRETION IN THE INVERTEBRATES **(15hrs)**

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan, Mollusca and Echinodermata- Filter feeding in Polychaeta.**Organs of respiration**: Gills, book lungs, and

trachea – Mechanism of respiration. **Organs of excretion**: Coelomoducts, Nephridia and Malphigian tubules – Mechanism of excretion.

UNIT III : NERVOUS SYSTEM AND LARVAL FORMS OF INVERTEBRATES

(15hrs)

Nervous system: Primitive nervous system in Coelenterata and Echinodermata- Advanced nervous system in Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda) –**Larval forms** of Trematoda, Cestoda, Crustacea, Mollusca, Echinodermata and their evolutionary significance.

UNIT IV : FUNCTIONAL MORPHOLOGY OF CHORDATES (15hrs)

Classification of chordates – Origin and evolution of elasmobranchs – **Adaptive radiation of elasmobranches and bony fishes** – **Migration in fishes** – **Origin and evolution of Amphibia** – Adaptive radiation in Amphibia – Terrestrialization

UNIT V : STRUCTURE AND FUNCTIONS OF VARIOUS ORGANS IN MAMMALS

(15hrs)

Connecting links between reptiles and birds – **Mammals**: Structural peculiarities of prototheria, metatheria and eutheria. – Structure and functions of integument and its derivatives - Origin and evolution of paired fins and limbs. **Evolution of urinogenital system in vertebrates**– Comparative anatomy of brain in vertebrates.

B.Topics for Self-Study:

S.No.	TOPICS	WEB LINKS
1.	Conjugation in Paramecium	https://www.allamaiqbalcollege.edu.in/uploads/download_2004051131.pdf
2.	Canal system in sponges	https://www.studyandscore.com/studymaterial-detail/phylum-porifera-canal-system-in-sponges-types-of-canal-systems-in-sponges-functions-of-water-current
3	Water vascular system in Echinodermata	https://www.biologydiscussion.com/invertebrate-zoology/phylum-echinodermata/water-vascular-system-of-echinoderms/33754
4.	Parental care in Amphibians	https://www.amu.ac.in/emp/studym/100007686.pdf
5.	Migration in fishes	https://www.onlinebiologynotes.com/migration-in-fishes/

C.Text Books:

1. Ruppert E.E., Fox, R.S. and Barnes, R.D. Invertebrate Zoology. 7th Ed., Cenage Learning, Singapore, 2004.

2. Jordan E.L. and Verma P.S., Invertebrate Zoology,12thedn. Schand& Co. 1995.

3. Kotpal R.L., Agarwal, R.P.R., Khertarpa,Modern text book of Zoology-I –Rastogi Publications.1989.

4. Jordan E.L, Verma P.S, Chordate Zoology -S.Chand& Company Ltd. 2008

5. KotpalR.L.A, Modern text book of Zoology Vertebrates, Rastogi publications, 2009.

D.Reference Books:

1. Linzey, D., Vertebrate Biology, McGraw-Hill, Singapore, 2001.

2. Waterman A.J., Chordate Structure and Function, The Macmillan Publishing Co., 1971.

3. Pough H., Heisher J.B. and McFarlandW.N., Vertebrate Life. Macmillan Publishing Co., New York, 1990.

4. HymanL.H., The Invertebrates, Vol. 1 to7, McGraw Hill Book Co., Inc., New York, 1940.

5. Barrington E.J.W., Invertebrate Structure and Functions, 2nd Ed., Thomas Nelson & Sons Ltd., Middlesex, United Kingdom, 1979.

6. Colbert H. E., Evolution of the Vertebrates, New Delhi, New Age International, 2000.

7. Jollie M, Chordate Morphology, Reinholt Publishing Corporation, New York, 1962.

8. Romer A.S., Hyman's Comparative Vertebrate Anatomy,3rd Ed., The University of Chicago Press, London, 1979.

9. Young J.Z., Life of Vertebrates, Clarendon Press, Oxford, 1950.

10. Sinha, Adhikari, Ganguly, BharatiGoswami,Biology of animals Vol.II., New central book agency (p) ltd., 2004.

E.Web links:

https://courses.lumenlearning.com/wm-biology2/chapter/invertebrate-chordates/

http://www.opentextbooks.org.hk/ditatopic/35145

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit /Section	CONTENTS	SPECIFIC LEARNING OUTCOMES (SLO)	HIGHEST BLOOM'S TAXONOMIC LEVEL OF TRANSACTION
I	**CLASSIFICATION OF ANIMAL KINGDOM**		
1.1	**Broad classification of Animal kingdom**	• Classify the various phylum on the basis of their characters • List out the rules of zoological	**K4**

	International code of Zoological nomenclature	nomenclature	
1.2	**Symmetry and its significance** in animal organization	• Explain the different types of symmetry and its importance	**K5**
1.3	**Organization of coelom**: Acoelomates – Pseudocoelomates – Coelomate groups (schizocoel, enterocoel, and mesenchyme).	• Compare and classify the animals based on their coelomic organization	**K5**
1.4	**Locomotion**:Amoeboid, flagellar and ciliary movement in Protozoa	• Illustrate the mechanism of locomotion in lower order invertebrates with examples	**K2**
1.5	**Hydrostatic movement** in Coelenterata and Echinodermata.	• Elaborate the typeof locomotion in higher order invertebrates	**K6**
II	**DIGESTION, RESPIRATION AND EXCRETION IN THE INVERTEBRATES**		
2.1	**Nutrition and Digestion**: Patterns of feeding and digestion in lower metazoan, Mollusca and Echinodermata	• Explain the mechanism and pattern of digestion in various phyla	**K5**
2.2	**Filter feeding** in Polychaeta	• Interpret the mechanism of feeding in Polychaeta	**K5**
2.3	**Organs of respiration**: Gills, book lungs, and trachea	• Distinguish the role of respiratory organs in various phylum	**K4**
2.4	**Mechanism of respiration**	• Elaborate the respiratory mechanism in higher order invertebrates	**K6**
2.5	**Organs of excretion**: Coelomoducts, Nephridia and Malphigian tubules	• List out the different excretory organs and its significance	**K4**

2.6	**Mechanism of excretion.**	• Explain the mechanism of excretion	**K5**
III	**NERVOUS SYSTEM AND LARVAL FORMS OF INVERTEBRATES**		
3.1	**Primitive nervous system** in Coelenterata and Echinodermata	• Identify the grade of nervous system in Coelenterates and Echinoderms	**K3**
3.2	**Advanced nervous system** in Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)	• Justify that Annelids has an advanced type of nervous system	**K5**
3.3	**Larval forms** of Trematoda, Cestoda, Crustacea, Mollusca, Echinodermata and their evolutionary significance.	• List out the various larval forms and its evolutionary significance	**K4**
IV	**FUNCTIONAL MORPHOLOGY OF CHORDATES**		
4.1	**Origin and evolution of elasmobranchs** **Adaptive radiation** of elasmobranches and bony fishes	• Explain the origin and evolution of elasmobranchs and the mechanism of adaptive radiation	**K5**
4.2	**Migration in fishes**	• Illustrate the process of migration in fishes with examples	**K2**
4.3	**Origin and evolution of Amphibia** **Adaptive radiation in Amphibia**– Terrestrialization	• Summarize the origin, evolution and adaptive radiation mechanism in amphibians	**K2**
V	**STRUCTURE AND FUNCTIONS OF VARIOUS ORGANS IN CHORDATES**		
5.1	**Connecting links between reptiles and birds**	• Categorize the animals which serves as the connecting link between the birds and reptiles	**K4**

5.2	**Mammals**: Structural peculiarities of prototheria, metatheria and eutheria.	• Classify the mammals based on their structural similarities	**K4**
5.3	**Structure and functions of integument** and its derivatives	• Explain the structure and functions of integumentary system with examples	**K5**
5.4	**Origin and evolution of paired fins and limbs**	• Examine the evolutionary pattern of fins and limbs	**K4**
5.5	**Evolution of urinogenital system in vertebrates**	• Interpret the evolutionary significance of urinogenital system in mammals	**K5**
5.6	**Comparative anatomy of brain** in vertebrates	• Compare the anatomy of brain and its functions in mammals	**K4**

4. Mapping Scheme for the PO, PSOs and COs

P19ZY101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	H	H	M	-	-	H	M	M	H
CO2	M	-	-	-	-	M	H	H	-	M	M	H	H
CO3	H	H	H	M	M	-	H	M	-	H	H	-	M
CO4	-	M	M	H	H	H	-	H	H	M	H	H	-
CO5	-	M	H	M	-	M	M	-	H	-	-	M	M
CO6	H	M	-	H	H	M	-	M	-	H	M	H	H

L-Low M-Moderate H- High

Direct

5. COURSE ASSESSMENT METHODS

1. Continuous Assessment Test I,II 2. Assignment, Group Presentation, Poster preparation 3. End Semester Examination
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.J.NESARAJAN

Core Course: II CELL BIOLOGY

SEMESTER : 1 **COURSE CODE : P19ZY102**
CREDITS : 5 **HOURS/ WEEK: 5**

1. Course Outcomes:

On completion of the course, the students will be able to :

CO. NO	COURSE OUTCOMES	Level	Unit
CO1	Distinguish prokaryotic and eukaryotic cells through basic structural organizations. Analyzing membrane structures and protein transport.	K4	I
CO2	Examine the functional significance of mtiochondria, NPC, Intra cellular traffic and cytoskeleton structure	K4	II
CO3	Analyze cell-cell interaction, receptor based signal transduction, cell cycle and its control systems with check points	K4	III
CO4	Identify the mode of cell growth, death through apoptosis and tissue maintenance.	K4	III
CO5	Explain the significance of stem cells, types and its mechanism of self renewal and potency, stem cell characterization and IPS generation with application.	K5	IV
CO6	Evaluate the molecular pathogenesis of cancer, role of oncogene/ tumor viruses, survival and death pathways and recent treatment strategies.	K5	V

2. A. SYLLABUS

Unit : I **(15 Hrs)**

PROKARYOTIC & EUKARYOTIC CELLS

Prokaryotic and eukaryotic cells. **Membrane structure:** lipid composition-protein components-principles ofMembrane transport-carrier proteins-Ion channels and membrane potential - Cell junctions-Extra cellular matrix. **Intracellular compartments:** Endoplasmic reticulum, Golgi complex and lysosomes- Transport and sorting of proteins-vesicular transport-secretory pathways.

Unit: II **(15 Hrs)**

STRUCTURE & FUNCTION OF CELLUAR ORGANELLES

Structure and functional significance of Mitochondria. Structure of Nucleus - Nuclear pore complexes – Transport of molecules between the nucleus and cytosol. **Cytoskeleton**: Centriole - Dynamic structure of microfilaments, intermediate filaments and microtubules - molecular motors-cytoskeleton and cell behavior.

Unit : III **(15 Hrs)**

CELL COMMUNICATION & CELL CYCLE

Cell communication: General principles- G-protein linked receptors–enzyme linked receptors-pathways of intracellular signal transduction.**Cell cycle control and cell death**:

overview of cell cycle-control system – apoptosis-extracellular control of cell growth- Tissue maintenance and renewal.

Unit : IV **(15 Hrs)**

STEM CELLS

Stem cells: Types- Molecular Basis of Pluripotency - Stem Cell Niches - Mechanisms of Stem CellSelf-Renewal - Generation of Induced Pluripotent Stem Cells -Characteristics and Characterization of Pluripotent stem Cells- Application of Embryonic stem Cells.

Unit : V **(15 Hrs)**

CANCER BIOLOGY

Biology of cancer: Development and causes of cancer-properties of cancer cells- Tumor viruses–Oncogenes - Tumor suppressor genes- Molecular basis of cancer- Cell behavior- Molecular Approaches to Cancer Treatment - Apoptosis

B.Topics for Self -Study:

S.No	Topics	Weblinks
1.	Senescence	**https://www.ncbi.nlm.nih.gov/books/?term=Senescence**
2.	SiRNA	**https://www.ncbi.nlm.nih.gov/books/?term=SiRNA**
3.	Cell adhesion	**https://www.ncbi.nlm.nih.gov/books/?term=Cell+adhesion**
4.	Molecular chaperons	**https://www.ncbi.nlm.nih.gov/books/?term=Molecular+chaperons**
5.	Protein folding	**https://www.ncbi.nlm.nih.gov/books/?term=Protein+folding**

C. Text Books:

1. Alberts, B., Johnson, A. and Lewis, J. Molecular Biology of the Cell. 4th Ed., 2002New York: Garland,.
2. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology, 8th Ed., 2001Lippincott Williams & Wilkins, A Wolter Kluwer Business, Philadelphia,

D. Reference Books:

1.Lodish H., Berr, A. and Paul, M. Molecular Cell Biology,2003. New York: W.H. Freeman,
2.CooperG.M. and Hausman, R.E., The Cell - A Molecular Approach. 4th Ed.,, 2007 Sinauer Associates Inc.USA.
3.KarpG. Cell and Molecular Biology,2008 G. John Wiley & Sons,.
4.SheelerP. andBianchi, D.E., Cell and Molecular Biology, 3rd Ed., 2009.JohnWiley Indian Edition, New Delhi,
5.Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G.P.,The World of Cell, 6th Ed., 2007Pearson Education

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E. Web Links:

file:///C:/Users/welcome/Downloads/Molecular_Biology_of_the_Cell_6th_Editio.pdf
https://nptel.ac.in/courses/102/103/102103012/
https://onlinecourses.swayam2.ac.in/cec20_ma13/preview

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Course Contents	Specific Learning Outcomes (SLO)	Blooms Taxonomy levels of Transaction
I	**PROKARYOTIC & EUKARYOTIC CELLS**		
1.1	Prokaryotic and eukaryotic cells Organizations	• Classify different cell types	K2
1.2	**Membrane structure:** lipid composition-protein components	• Compare membrane structure of different cells	K2
1.3	Principles of Membrane transport-carrier proteins-Ion channels and membrane potential - Cell junctions-Extra cellular matrix.	• Explain the principle of transport molecules between the membranes, • Carrier protein, Ion channels, cell junctions and its functions	K4
1.4	**Intracellular compartments:** Endoplasmic reticulum, Golgi complex and lysosomes- Transport and sorting of proteins-vesicular transport-secretory pathways.	• Explain the structure, function and biochemical properties of each of the cell organelles. Intra cellular movements of molecules and within EMS	K2
II	**STRUCTURE & FUNCTION OF CELLUAR ORGANELLES**		
2.1	Structure and functional significance of Mitochondria. Structure of Nucleus - Nuclear pore complexes – Transport of molecules between the nucleus and cytosol.	• Explain structural and functional properties of mitochondria, nucleus and transport between cytoplasm and nucleus.	K2

2.2	**Cytoskeleton**: Centriole - Dynamic structure of microfilaments, intermediate filaments and microtubules - molecular motors- cytoskeleton and cell behavior.	• Explain structure and function of CSKs and motor proteins in relation to cell behavior	, K4
III	**CELL COMMUNICATION & CELL CYCLE**		
3.1	**Cell communication:** General principles- G-protein linked receptors– enzyme linked receptors- pathways of intracellular signal transduction.	• Explain receptors and its role in signal transduction pathways and cell communication.	K3
3.2	**Cell cycle control and cell death**: overview of cell cycle-control system – apoptosis-extracellular control of cell growth- Tissue maintenance and renewal.	• Explain cell cycle events, control systems, check points and cell cycle regulation. Understanding the significance of apoptosis in tissue maintenance and renewal.	K4
IV	**STEM CELLS**		
4.1	**Stem cells:** Types- Molecular Basis of Pluripotency - Stem Cell Niches - Mechanisms of Stem CellSelf-Renewal -	• Classify the types of stem cells and its niches. Illustrate the mechanism of self renewal and potency.	K2
4.2	Generation of Induced Pluripotent Stem Cells - Characteristics and Characterization of Pluripotent stem Cells- Application of Embryonic stem Cells	• Explain the importance of IPS & stem cell therapy	K5
V	**CANCER BIOLOGY**		
5.1	**Biology of cancer:** Development and causes of cancer-properties of cancer cells- Tumor viruses–Oncogenes - Tumor suppressor genes- Molecular basis of cancer- Cell behavior-	• Analyse the Biology of cancer cells, pathogenesis, properties, genes and factors involved,	K4

5.2	Molecular Approaches to Cancer Treatment - Apoptosis	• Develop novel strategies for cancer treatment	K5

4. Mapping Scheme for the PO, PSOs and COs

P19ZY102	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	L	M	H	H	M	H	H	H	M
CO2	H	H	H	M	L	M	H	H	M	H	H	H	L
CO3	H	H	H	H	L	M	H	H	M	H	H	H	L
CO4	H	H	H	L	L	M	H	H	M	H	H	H	L
CO5	H	H	M	M	L	M	H	H	M	H	H	H	M
CO6	H	H	H	H	L	M	H	H	M	H	H	H	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

1. **Continuous Assessment Test I,II**
2. **Assignment; Group Presentation, Poster preparation,**
3. **End Semester Examination**

COURSE CO-ORDINATOR: Dr.KAMALA KANNAN

CORE – III: MOLECULAR BIOLOGY AND BIOINFORMATICS

SEMESTER: I **COURSE CODE : P19ZY103**
CREDITS : 5 **HOURS / WEEK: 5**

COURSE OUTCOMES:
After completing this course, the students will be able to:

CO. NO	COURSE OUTCOMES	LEVEL	UNIT
CO1.	Explain the structure, synthesis and function of biomolecules.	K2	1
CO2.	Interpret the C-value paradox and its importance.	K2	I
CO3.	Compare the process of DNA replication in both Prokaryotes and in Eukaryotes	K5	II
CO4.	Analyze the process of transcription and gene expression in eukaryotes.	K4	III
CO5.	Distinguish the types of various biological databases and tools used for protein structure visualization.	K5	IV
CO6.	Compare and relate the alignment tools used in evolution and in drug designing.	K5	V

2.A. SYLLABUS

Unit – I : STRUCTURE AND FORMS OF DNA (15 Hrs)

Structure of DNA, tRNA, micro -RNA. Forms of DNA - Mitochondrial DNA - structure of eukaryotic chromosome- nucleosome model- heterochromatin and euchromatin - Genome size and C value paradox. Unique and Repetitive nucleotide sequences in eukaryotic genome (LINEs, SINEs). Kinetics of renaturation: Cot curve.

Unit – II: DNA REPLICATION AND CENTRAL DOGMA IN PROKARYOTIC CELLS

(15 Hrs)

DNA replication: semi conservative, rolling circle, Q, D, Eye–models- Mechanism of replication –DNA damage and its repair mechanisms. **Genetic code:** Properties- Wobble hypothesis. **Transcription in Prokaryotes:** enzymes and proteins involved – mechanism –promoters- enhancers . **Protein synthesis in Prokaryotes:** Ribosomes - factors involved in protein synthesis - process of translation-post translational modifications and signal hypothesis - inhibitors.

Unit – III: REGULATION OF GENE EXPRESSION IN PROKARYOTES
(15 Hrs)

Transcription in Eukaryotes: RNA polymerases - promoters- enhancers and silencers - effects of chromatin structure. Post-transcriptional modifications -**Regulation of gene expression:** concepts of enzyme induction and repression- positive and negative control. Regulation of gene expression in Prokaryotes: lac-operon, trp-operon, ara-operon and gal-operon. Catabolite repression. Regulation of gene expression in eukaryotes.

Unit – IV: BIOINFORMATICS DATABASES (15 Hrs)

Overview of Bioinformatics – Literature, sequence and structure databases – Pattern and motif searches: PROSITE, BLOCKS, PRINTS, PFAM – Structural classification: SCOP, CATH – Metabolic pathway databases: KEGG and Biocyc - Protein structure visualization tools: RasMol, Swiss PDB Viewer Molecular sequence alignment: Pair wise alignment - Local and Global alignment concepts – FASTA and BLAST - Multiple sequence alignment – CLUSTALW and TCOFFEE.

Unit – V: GENOMICS AND PROTEOMICS (15 Hrs)

Gene and Genome analysis: Genome projects - Genome Mapping, Sequencing, Assembly and Annotation - comparative genomics. **Protein and proteome analysis:** – Protein secondary structure prediction - protein identification tools - Chou- Fasman /GOR method. Transcriptomics: Genome expression analysis using microarray techniques - Applications of Microarray- Modern drug discovery – CADD (Computer Aided Drug Discovery) - impact of structural bioinformatics in drug discovery.

B. Topics for Self -Study

NO	TOPICS FOR SELF-STUDY	WEB-LINKS
1.	DNA Replication: Eukaryotic Origins and the Origin Recognition Complex	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3779782/
2.	Histone Modifications	https://www.nature.com/articles/cr201122
3.	DNA Repair and Cancer	https://www.ncbi.nlm.nih.gov/books/NBK21554/
4.	Metabolite profiling and Biomakers analysis	https://www.nature.com/articles/s41598-017-01735-y
5.	Modeling and simulation in drug development	https://www.pharmafocusasia.com/foreword/modelling-simulation-drug-development

C. Text Books

1. Malacinski G.M., Freifelder's Essential of Molecular Biology, Narosa Publishing House, New Delhi, 2003.
2. Jeyanthi G.P, Molecular Biology, MJP Publishers, Chennai. 2009.
3. Ignacimuthu S, Basic Bioinformatics, Narosa Publishing House, Chennai, 2008

D. Reference Books

1. Alberts, B., Johnson AandLewisJ, Molecular Biology of the Cell, 4th Ed., New York: Garland, 2002.
2. WeaverR, Molecular Biology, 5th Ed., McGraw-Hill, NY, 2012.
3. Lodish H, Berr A and Paul M, Molecular Cell Biology, New York, W.H. Freeman, 2003.
4. Epstein R.J, Human Molecular biology, An Introduction to the molecular basis of health disease, Cambridge University Press,2003.

5. ColladovidesJ.,MagasanikB and Smith, T.F. Integrative approaches to Molecular Biology. Ane Books, New Delhi.2004.
6. Lewin B, Genes IX, Jones and Bartlett Publishers, Boston, 2008.
7. BatesA. D. and MaxwellA, DNA Topology, Oxford University Press Inc., New York, Indian Edition, 2005.
8. David H.R., Genetics and Molecular Biology, Tata McGraw, New Delhi, 2009.
9. Lewin B., Krebs J. E., Kilpatrick S.T. and Goldstein, E.S. Lewin's GENES X. John and Barlett Publishers, Sudbury Massachusetts, 2011.
10. Watson J.D., BakerT.A., BellS.P., GannA., LevineM. and Losick R, Molecular Biology of the Gene, 5th Ed., Pearson EducationInc, 2004.
11. Teresa K. Attwood, David Parry-Smith.,Introduction to Bioinformatics. Pearson Education. 2001 Highest level of Blooms Taxonomy

E. Web Links:

https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/3%3A_Genetics/15%3A_Genes_and_Proteins/15.3%3A_Eukaryotic_Transcription

https://www.sciencedirect.com/science/article/pii/S2352873717300653

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC186575/

3. SPECIFIC LEARNING OUTCOME (SLO)

Unit /section	**Course Contents**	**Learning Outcomes**	**Highest Blooms Taxonomy level of Transaction**
1	**STRUCTURE AND FORMS OF DNA**		
1.1	Structure Of DNA	• Explain the Watson & Crick model of DNA	K2
		• Analyse the backbone of DNA	K4
		• Explain the X-ray diffraction studies of DNA	K5
1.2	Structure of t-RNA	• Analyse the clover leaf model structure of t-RNA	K4
		• Explain the functions of t-RNA	K2
	Structure of micro RNA	• Define and analyse the non-coding RNA	K4
		• Explain the functions of non-coding RNA	K6
	Forms of DNA	• Explain the different forms of DNA	K4

1.3		• Compare and Interpret the molecular basis of different forms of DNA	K5
1.4	Mitochondrial DNA	• Define and identify the components of Mitochondrial DNA.	K3
		• Compare the functions of mitochondrial DNA and highlight its importance	K5
1.5	Structure of Eukaryotic chromosome	• Analyse the chromatin organization and nucleosomes.	K4
		• Explain the four motifs that play a major role in DNA binding	K5
1.6	Nucleosomes Model	• Compare the first order and second order DNA coiling.	K4
		• Explain the core structure of nucleosomes and histones	K5
1.7	Heterochromatin & Euchromatin	• Infer the structure of heterochromatin and euchromatin.	K4
		• Explains the solenoid model of chromosome.	K5
1.8	Genome size	• Compare the variation and genome size.	K5
		• Explain the types of DNA sequences in Humans	K5

1.9	C Value Paradox	• Discover the variation of C-value paradox among species • Interpret the importance of C-value paradox in evolution	K4 K5
1.10	Unique and Repetitive nucleotide sequences in eukaryotic genome (LINEs, SINEs)	• Identify the repetitive nucleotide sequences • Explain the total repetitive nucleotide sequences in eukaryotic genome	K4 K5
II	**DNA REPLICATION AND CENTRAL DOGMA IN PROKARYOTIC CELLS**		
2.1	Kinetics of renaturation: Cot curve	• Analyse the Cot curve and infer the results	K4
2.2	DNA replication	• Explain the process of DNA replication.	K5
		• List out the requisites of DNA replication.	K4
		• Analyse the models of replication in leading strand	K4
		• Compare the models of DNA replication	K5
	Semi conservative replication	• Explain and defend the Meselson & Stahl's experiment on semi conservative model applications	K5
2.3	Models of replication- Semi conservative, conservative and dispersive	• Discuss and compare the different models of replication	K6
		• Explain the three types of models of DNA replication	K5
2.4	Mechanism of replication- Initiation, Elongation and Termination	• Illustrate the steps in replication in formation of new strands	K6
		• Explain replisome and its molecular components with its functions	K5

2.5	DNA damage	• Infer the causes of DNA damage	K4
		• • List out the types of DNA damage	K4
2.6	DNA repair mechanism- Types of DNA repair systems- Mismatch repair, Base-excision, Nucleotide excision, Direct repair, Post replication & Error -prone	• Explain the mechanism of DNA repair mechanism	K5
		• List out the types of DNA repair mechanism	K4
2.7	Genetic code	• Explain the Wobble hypothesis with examples	K5
		• List out the features of genetic code	K4
2.8	Transcription in prokaryotes	• Explain the structure of RNA polymerase	K5
		• Prioritise the process of transcription in Prokaryotes	K5
2.9	Protein synthesis in Prokaryotes	• Identify the factors involved in protein synthesis	K4
		• Analyse the components of protein machinery of prokaryotes	K4
		• Explain the steps involved in protein synthesis	K5
2.10	Post translational modifications	• Infer the post translational modifications.	K4
		• List out the types of post translational modifications.	K4
2.11	Signal hypothesis	• Analyse the process of binding & release of the signal peptides	K4

		• Predict the importance of signal hypothesis in biomolecules	K6
III	**REGULATION OF GENE EXPRESSION IN PROKARYOTES**		
3.1	Inhibitors	• Identify the inhibitors of protein synthesis in prokaryotes.	K4
		• List out the inhibitors of protein synthesis	K4
3.2	Transcription in Eukaryotes: RNA Polymerases	• Explain the structure & function of RNA polymerase.	K5
		• Explains the types and functions of RNA polymerase	K5
3.3	Effects of chromatin structure	• Identify and explain the effects of chromatin structure	K5
		• Distinguish the types of chromatin and its role in cell division	K4
3.4	Post transcriptional modifications	• Interpret the post transcriptional modifications.	K5
		• List out the types of post translational modifications	K4
3.5	Regulation of gene expression- concepts of enzyme induction and repression- positive and negative control	• Analyze the process of regulation of gene expression.	K4
		• Distinguish the types of repression- positive and negative control	K4
3.6	Regulation of gene expression in prokaryotes- Lac operon, Trp Operon, Ara operon, Gal	• Interpret the positive and negative control of gene expression.	K5
		• List out the types of operons in prokarytes	K4

	operon		
3.7	Regulation of gene expression in eukaryotes	• Justify the gene expression in Eukaryotes and its feedback control	K5
IV	**BIOINFORMATICS DATABASES**		
4.1	Overview of Bioinformatics	• Explain the scope of bioinformatics	K5
		• Elaborate the importance of bioinformatics in various fields	K6
	Literature, sequence and structure databases	• Identify the different sequence & structure database.	K3
		• List out the types of sequence and structural databases	K4
4.2	Pattern and motif Searches	• Apply the secondary database for assessing pattern & motifs in proteins.	K3
		• List out the types of pattern and motifs databases in secondary structure	K4
4.3	Structural classification	• Classify & compare the structure of proteins	K5
		• Identify the databases applied in predicting the protein structure	K3
4.4	Metabolic pathway databases	• Analyze the metabolic pathways.	K4
		• List out the types of metabolic databases	K4
4.5	Protein structure visualization tools	• Interpret the 3D structure of proteins by using visualization tools	K5
		• List out the types of 3D structure of proteins visualization tools	K4
4.6	Molecular sequence alignment	• Apply the alignment tools for finding homology	K3
		• List out the tools applied for molecular sequence alignment	K3
V	**GENOME AND PROTEOME ANALYSIS**		
5.1	Gene and Genome analysis	• Infer the importance of human genome sequencing & mapping	K3
		• Apply the methods used for genome analysis	K3

5.2	Comparitive genomics	• Discuss the importance of comparative genomics in tracking evolution	K6
5.3	Protein and proteome analysis	• apply the concepts of proteomics in various fields	K3
5.4	Protein structure prediction methods	• Analyse the structure of proteins by prediction method	K4
		• Infer the secondary structure of proteins by structure prediction methods	K4
5.5	Transcriptomics	• Apply the micro array techniques for studying gene expressions	K3
		• Analyse the tools used for gene and mRNA expression	K4
5.6	Modern drug discovery	• Apply theCADD methods in drug designing.	K3
		• Explain the methods and tools used for modern drug discovery	K5

4. Mapping Scheme for the PO, PSOs and COs

P19ZY103	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO3	PSO4
CO1	H	M	H	H	M	H	M	M	M	H	H	M	H
CO2	H	M	H	H	M	H	M	M	M	H	H	M	H
CO3	H	M	H	H	M	H	M	M	M	H	H	M	H
CO4	H	M	H	H	M	H	M	M	M	H	H	M	H
CO5	H	H	H	H	M	H	M	M	M	M	M	H	M
CO6	H	H	H	H	M	H	M	M	M	M	M	H	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment, Presentation, Project report, Poster preparation.** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.J.JOONU

CORE PRACTICAL-I: LAB IN CELL BIOLOGY AND MOLECULAR BIOLOGY

SEMESTER: I **COURSE CODE: P21ZY1P1**

CREDITS: 3 **HOURS / WEEK: 5**

1. COURSE OUTCOMES

After completing this course, the students will be able to :

CO. NO	COURSE OUTCOME	LEVEL	Experiments
CO1	Examine the stages of mitotic cell division	K4	I
CO2	Analyze various events in cell division and cell cycle.	K4	I
CO3	Develop permanent slides and perform various staining procedures.	K6	I
CO4	Estimate protein/DNA using gel electrophoresis and analyze their molecular mass	K6	II
CO5	Test gene amplification using PCR	K5	II
CO6	Explain the significance of concentrating biomolecules	K5	II

2. A.SYLLABUS

I CELL BIOLOGY **(45 Hrs)**

1. Effect of Colchicine on Mitosis using onion root tip.
2. Study of giant chromosomes in chironomous larva and micrometric measurements of Puffs.
3. Methyl Green Pyronin staining of DNA and RNA in buccal smear
4. Histology: Fixation, dehydration, embedding, sectioning, staining and permanent mounting of tissues - Submission of 5 best slides for Exam evaluation
5. Histochemistry: Feulgen Reaction for DNA, Periodic Acid – Schiff (PAS) reaction for carbohydrates, Mercuric Bromophenol Blue staining for Proteins.

Spotters: Giant chromosome, Mitotic stages of onion root tip, T.S of Heart, T.S of Kidney, T.S of Pancreas, T.S of Liver

II MOLECULAR BIOLOGY **(35 Hrs)**

1. Isolation of genomic DNA from PBMC.
2. PAGE - separation and molecular weight determination of proteins.
3. Agarose gel electrophoresis of DNA and calculation of molecular weight.
4. Amplification of gene by PCR.
5. Gene expression through RT PCR(QPCR)
6. Western blotting technique

Spotters: PCR, PAGE and Agarose gel electrophoresis, Western blot

B. Topics for self study:

S.No	Topics	Web links
1.	FACS	**https://www.labome.com/method/Flow-Cytometry-and-Cell-Sorting-A-Practical-Guide.html**
2.	Cryopreservation	**https://assets.thermofisher.com/TFS-Assets/LSG/manuals/D21111.pdf**
3.	Immunohistochemistry	**https://link.springer.com/book/10.1007/978-1-4939-1578-1**
4.	Western Blotting	**https://vlab.amrita.edu/?sub=3&brch=187&sim=1331&cnt=1**
5.	Cell Culture	**https://atecentral.net/downloads/1163/Basics_of_Cell_Culture_students_manualv7.pdf**

C. Text Books:

1. Cell Biology : Practical Manual. Dr. Renu Gupta (Author), Dr. Seema Makhija (Author), Dr. Ravi. Prestige Publishers (2018)

2. Freshney, R. I. (2005). Culture of specific cell types. John Wiley & Sons, Inc.

3. Razdan, M. K. (2003). Introduction to plant tissue culture. Science Publishers.Reference book

D. Reference Books:

1. Essential Cell Biology: A Practical Approach Volume 1: Cell Structure (Practical Approach Series) 1st Edition. John Davey and J. Michael Lord. Oxford University Press; 1 edition (August 7, 2003) 2003

2. Sambrook, J., Russell, D. W., & Russell, D. W. (2001). Molecular cloning: a laboratory manual (3-volume set).

3. Cell and Molecular Biology: A Lab Manual. Chaitanya K.V. January 2013. Prentice Hall India Learning Private Limited

E. Web links:

https://b-ok.asia/book/5925611/120ff0

https://www.amrita.edu/school/biotechnology/academics/pg/cell-molecular-biology-lab-bio588

3. Specific Learning Outcomes (SLO):

Sl No	Course contents	Specific Learning Outcomes (SLO)	Blooms Taxonomy levels of Transaction
I	**Cell biology**		
1	Effect of Colchicine on Mitosis using onion root tip.	• Explain the stages of mitosis	K5
2.	Study of giant chromosomes in chironomous larva and micrometric measurements of Puffs.	• Examine Giant chromosomes in chironomous larva	K5
3	Methyl Green Pyronin staining of DNA and RNA in buccal smear	• Distinguish DNA and RNA using Methyl Green Pyronin staining	K5
4	Histology: Fixation, dehydration, embedding, sectioning, staining and permanent mounting of tissues - Submission of 5 best slides for Exam evaluation.	• Explain the importance of histology	K5
5	Histochemistry: Feulgen Reaction for DNA, Periodic Acid Schiff(PAS) reaction for carbohydrates, Mercuric Bromophenol Blue staining for Proteins.	• Estimate the presence of various biomolecules in the tissue using dyes.	K5
6	**Spotters:** Giant chromosome, Mitotic stages of onion root tip, T.S of Heart, T.S of Kidney, T.S of Pancreas, T.S of Liver	• Classify the various stages of cell division, DNA forms and histo-architecture of tissues	K2
II	**Molecular Biology**		
1	Isolation of genomic DNA from PBMC	• Examine isolation of DNA from White Blood cells	K5
2	PAGE - separation and molecular weight determination of proteins.	• Interpret tissue proteins through gel electrophoresis	,K5
3	Agarose gel electrophoresis of DNA and calculation of molecular weight.	• Interpret DNA using agarose gel electrophoresis	K5
4	Amplification of gene by PCR.	• Test gene amplification in the given sample	K5
5	Demonstration of Protein precipitation and purification.	• Explain concentrating protein in a given sample.	K5
6	**Spotters**: PCR, PAGE and Agarose gel electrophoresis	• Summarize the principle and applications of instrument used in	K2

		molecular biology.	

4. Mapping Scheme for the PO, PSOs and COs

P19ZY1P1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H	H	H	H	M	H	H	H	L
CO2	H	H	H	H	H	M	L	H	M	H	H	H	L
CO3	H	H	H	H	H	M	M	H	L	H	H	H	L
CO4	H	H	H	H	H	L	H	H	L	H	H	H	L
CO5	H	H	H	H	H	M	L	H	M	H	H	H	M
CO6	H	H	H	H	H	L	L	H	L	H	H	H	M

L-Low **M-Moderate** **H- High**

5. COURSE ASSESSMENT METHODS

1. **Continuous Assessment Test I,II**
2. **Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,**
3. **End Semester Examination**

COURSE CO-ORDINATOR: Dr.KAMALA KANNAN

CORE PRACTICAL –II: LAB IN MICROBIOLOGY/PARASITOLOGY

SEMESTER: I **COURSE CODE: P19ZY1P2**

CREDITS: 3 **HOURS / WEEK: 5**

1. Course Outcomes

After completing this course, the students will be able to :

CO.No	COURSE OUTCOMES	LEVEL	UNIT
CO1	Categorise and determine the bacteria based on colony morphology	**K4**	**I**
CO2	Assess the different bacterial culture techniques applied for isolating pure culture.	**K5**	**I**
CO3	Determine the growth of bacteria in four stages by Spectrophotometry method.	**K5**	**I**
CO4	Evaluate the antibiotic sensitivity of bacteria by Disc Diffusion method.	**K5**	**I**
CO5	Justify the similarities between multiple sequences & to track the evolution.	**K5**	**II**
CO6	Determine the 3D structure of protein and to assess the phylogenetic relationship between the organisms.	**K5**	**II**

2. A.SYLLABUS

I Microbiology **(45hrs)**

1. Sterilization procedures and maintenance of laboratory.

2. Media preparation and bacterial culture inoculation.
3. Identification of bacteria based on colony morphology and colony counting.
4. Serial dilution and pour plate method and determination of colony number/gram.
5. Culture techniques :Broth culture, Spread plate, Streak plate, Slant culture &Swab culture
6. Identification of bacteria by gram staining method..
7. Determination of bacterial growth by spectrophotometry.
8. Antibiotic sensitivity test.
9. MPN technique for the identification of coliforms in water samples.
10. Bio- Chemical tests for bacterial identification. (IMVIC)

Spotters: Fungi and culture plates

Instruments: Laminar air flow and Colony counter

II-Bioinformatics **(35hrs)**

1. Basic local Alignment methods – BLAST, FASTA
2. Multiple Alignment methods–Clustal X
3. Structural Data Base -3D structure of proteins– PDB, Swiss Prot
4. Phylogenetic tree relationship- Distance tree results and neighbor joining tree method

B.Topic for Self-study:

No	TOPICS FOR SELF-STUDY	WEB-LIINKS
1.	Introduction to the use of practical laboratory microscopes	https://www.pdfdrive.com/practical-microbiology-e12040951.html
2.	Basic bacterial cultivation techniques	https://www.pdfdrive.com/practical-microbiology-e12040951.html
3.	Transfer, maintenance and storage of pure cultures	https://www.pdfdrive.com/practical-microbiology-e12040951.html
4.	Schaeffer-fulton spore staining	https://www.pdfdrive.com/practical-microbiology-e12040951.html

C. Text Book:

1. Laboratory Manual in Microbiology. P.Gunasekaran . New Age International, 2007 .

D. Reference Books:

1. Laboratory Manual: Microbiology Principles and Applications. Stephen A. Norrell Prentice Hall, 1990 - Medical microbiology.
2. Microbiology: A Laboratory Manual- James G. Cappuccino, Natalie Sherman Pearson Education, 20-Feb-2013
3.Bioinformatics Practical Manual . Mohammed Iftekhar · Createspace Independent Publishing Platform 2015.
4. Introduction to Bioinformatics Using Action Labs- Jean-Louis Lassez, Ryan Rossi, Stephen Sheel · Published by Lulu.com2016

E. Web links:

https://bio.libretexts.org/Bookshelves/Ancillary_Materials/Laboratory_Experiments/Microbiology_Labs/Microbiology_Labs_I/03%3A_Dilution_Techniques_and_Pipetting

https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0211962

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Course Contents	Specific Learning Outcomes (SLO)	Highest level of Blooms Taxonomy
	MICROBIOLOGY		
1	Sterilization procedures and maintenance of laboratory	• Apply the sterilization procedures and lab maintenance	K3
2	Media preparation and bacterial culture inoculation	• Assess the types of media prepare for bacterial culture	K5
3	Identification of bacteria based on colony morphology.	• Identify the bacteria based on colony morphology	K3
4	Serial dilution and pour plate method and determination of colony number/gram.	• Analyse the process of serial dilution to isolate pure culture	K4
		• Determine the process of pour culture method	K5
		• Predict the total number of bacterial colony count /gram.	K6
5	Culture techniques :Broth culture, Spread plate, Streak plate, Slant culture &Swab culture	• Evaluate and analyse the strains of bacteria using different culture techniques.	K6
6	Identification of bacteria by gram staining method	• Identify the bacteria based on gram staining.	K3
		• Assess the bacterial strain type based on grams staining.	K5

7	Determination of bacterial growth by spectrophotometry -	• Determine the growth of bacteria by Spectrophotometry method.	K5
		• Evaluate the stages of bacterial growth	K5
8	Antibiotic sensitivity test.-	• Evaluate the antibiotic sensitivity of bacteria by Disc Diffusion method.	K5
		• Determine the antibiotic sensitivity in bacteria using different concentration of antibiotics.	K5
9	MPN technique for the identification of coliforms in water samples	• Analyse the Coliform bacteria in the drinking water by MPN method.	K4
		• Analyse the water portability test.	K4
10	Biochemical test for bacterial identification- IMViC	• Identify the gram negative bacteria by biochemical test.	K3
		• Analyse the bacterial strains for identification at genus level by IMViC tests	K4
	SPOTTERS	•	
11	Spotters- Fungi and culture plates	• Analyse & compare the bacteria based on its morphology.	K4

		• Analyse & compare the fungi based on its morphology	K4
12	Instruments-Laminar air flow, Colony counter	• Explain the principle & applications of the instruments.	K5
	• **BIOINFORMATICS**		
1	Basic Local Alignment **methods-BLAST & FASTA**	• Compare & determine the similarities between the two local sequences using BLAST.	K5
		• Compare & determine the similarities between the two local sequences using FASTA.	K5
2	Multiple alignment methods-Clustal X	• Identify similarities between multiple sequences & to track the evolution	K5
		• Predict and apply the multiple alignment between the sequences using CLUSTAL X	K6
3.	Structural database-3D structure of proteins-PDB,SwissProt	• Determine the 3D structure of proteins	K5
		• Apply the 3D structure of protein to predict the annotations of the protein	K3

4.	Phylogenetic relationship-Distance tree results and neighbor joining tree method	• Assess the phylogenetic relationship between the organisms.	K5
		• Apply the phylogenetic relationship between the organisms to track evolution	K3

4. Mapping Scheme for the PO, PSOs and COs

P19ZY1P2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO3	PSO4
CO1	H	M	H	H	H	H	M	H	M	M	M	H	H
CO2	H	H	H	H	H	H	M	H	M	M	H	H	H
CO3	H	M	H	H	H	H	L	H	M	M	H	H	H
CO4	H	M	H	H	H	H	L	H	M	M	H	H	H
CO5	H	H	H	H	H	H	L	H	H	M	M	H	H
CO6	H	H	H	H	H	H	L	H	H	M	M	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Posterpreparation,** **3. End SemesterExamination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.J.JOONU

ELECTIVE – I: MICROBIOLOGY/PARASITOLOGY

SEMESTER: I **COURSE CODE: P20ZY1:1/P19ZY1:A**

CREDITS: 5 **HOURS / WEEK: 5**

1. COURSE OUTCOMES:

After completing this course, the students will be able to

CO. NO	COURSE OUTCOME	LEVEL	UNIT
CO1	Explain the structure, function, diversity, metabolism, and the genetics of metabolic regulation microorganisms.	K5	I
CO2	Explain the nutrient types essential for the microbial growth	K5	II
CO3	Discuss about the multiplication and the physical factors influencing the growth of microbes.	K6	III
CO4	Identify and assess the various accessory pigments and their functions for major metabolic processes	K2	IV
CO5	Explain the functional role of microbes in large scale industries	K5	V
CO6	Categorize the diverse threat of microorganisms causing deadliest diseases	K2	VI

2. A.SYLLABUS

Unit – I MICROBES: CLASSIFICATION AND STRUCTURE 15hrs

Microbial diversity: Whitakers system of classification. **Bacteria**: Structure of *E.coli*- Cytoplasmic membrane – cell wall – gram positive and gram negative bacterial cell surface structures- cell inclusions– gas vesicles- endospores - locomotion – nutrition types in bacteria. **Virus**: Structure and life cycle of Bacteriophage.

Fungi: Structure and life cycle of *Penicillium*.

Unit – II MICROBIAL CULTURE AND GROWTH 15hrs

Microbial culture and growth: Types of culture–culture media. Cell division - peptidoglycon synthesis-measurement of microbial growth - exponential growth- growth curves –growth kinetics –**Factors affecting growth**: temperature, pH and oxygen.

Unit – III AEROBIC AND ANAEROBIC RESPIRATION 15hrs

Phototrophy: Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids and phycobilins **Chemolithotrophy:** inorganic electron donors -

hydrogenoxidation- sulfur oxidation- iron oxidation- nitrification. **Anaerobic respiration:** nitrate reduction- sulfur reduction- acetogenesis - methanogenesis - organic electron acceptor.

Unit – IV MICROBIAL PRODUCTS 15hrs

Industrial Microbiology: Microbial products -primary and secondary metabolites- characteristics of large-scale fermentations- Antibiotics isolation and characterization- Industrial production of vitamins-steroids - enzymes - alcohol-vinegar-citric acid.

Unit – V MICROBIAL DISEASES 15hrs

Medical microbiology: Symptoms, prevention and control of **Air borne infections:** Tetanus - tuberculosis- respiratory viral infections : COVID-19, Zoonotic diseases – Polio - influenza. **Water borne infections**: - hepatitis. Helicobacter pylori and Gastric ulcer – Leprosy - Sexually Transmitted Diseases: Gonorrhea-Syphilis - AIDS.

B. Topics for Self-Study:

S.No.	Topics	Web Links
1	Virtualization Proteins as Indicators of Phylogeny	https://academic.oup.com/peds/article/14/9/609/1551466
2	Quorum Sensing and Microbial Populations	https://elifesciences.org/articles/25773
3	Specialty Compounds for Use in Medicine and Health	ftp://ftp.hpl.hp.com/wilkes/AutoRAID.TOCS.ps.Z
4	Microbial Mechanisms for Escaping Host Défense	https://www.immunology.org/public-information/bitesized-immunology/pathogens-and-disease/host-%E2%88%92-pathogen-interactions-and

C. Text Books:

1. Pelczar M.J and Reid,Microbiology,1996.Tata Mc Graw Hill,
2. Prescott L.M., HarleyJ. P. and KleinD.A.,Microbiology, 6th Ed.,2005. McGraw-Hill,New Delhi,

D. Reference Books:

1. Pomervill P.C., Alacamo's Fundamentals of Microbiology, 7th Ed., 2004.Boston: Jones and Bartlett,
2. Tartora G.J., Case C.L. and Funke B.R., Microbiology - An Introduction, 8th Ed.,2004. Pearson Benjamin Cummings, New York,
3. Hogg S,Essential Microbiology, 2005.John Wiley & Sons Ltd., England,
4. Madigan M.T. and MartinkoJ.M.,Brock Biology of Microorganisms, 11th Ed., 2006.Prentice Hall, USA,
5. Percival S.L., Chalmers RM, Embrey M., Hunter PR, Sellwood J and Wyn-Jones P, Microbiology of Waterborne Diseases,2004 Elsevier Academic Press, London,.

6. Schaechter M, The Desk Encyclopedia of Microbiology,2004 Elsevier Academic Press, London,.

E. Web Links:

1. https://www.biologydiscussion.com/bacteria/structure-of-bacteria-with-diagram-microbiology/54559

2. https://sfamjournals.onlinelibrary.wiley.com/doi/10.1111/jam.14218

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit	Course Contents	Specific Learning Outcomes (SLO)	Highest Bloom's taxonomy level
I	**MICROBES : CLASSIFICATION AND STRUCTURE**		
1.1	Microbial diversity	Classify the microorganisms with Whitaker's classification	K2
1.2	Bacteria	Explain the structure and classification of bacteria	K5
1.3	Virus	Explain the structure and life cycle of viruses	K5
1.4	Fungi	Explain the structure and life cycle of Fungi	K5
II	**MICROBIAL CULTURE AND GROWTH**		
2.1	Microbial cultural growth	Classify the various types of culture media for the growth of microbial growth	K2
		Determine the stages of cell division and their functions	K6
		Explain about the growth curve and kinetics	K5
2.2	Factors affecting growth	Assess the importance of physical factors essential for the growth	K5
III	**AEROBIC & ANAEROBIC RESPIRATION**		
3.1	Phototrophy and Chemolithotrophy	Explain the structure and importance of photosynthetic pigments	K5
		Elaborate the process of metabolism occur in bacteria	K6

3.2	Respiration	Explain the mechanism of anaerobic respiration in microorganisms	K5
IV	**MICROBIAL PRODUCTS**		
4	Industrial microbiology	Classify the different microbial products and their metabolite characters	K2
		Estimate about the large scale fermentations of essential needs of human beings	K5
V	**MICROBIAL DISEASES**		
5	Medical microbiology	Interpret the symptoms of major infections	K5
		Explain the prevention and control of deadly microbes	K2
		Classify the various Airborne, water borne and sexually transmitted diseases with their symptoms	K2

4. Mapping Scheme for the PO, PSOs and COs

P19ZY1:1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	H	M	H	H	H	H	H	H
CO2	H	H	H	H	H	H	M	H	H	H	H	H	H
CO3	H	H	H	H	H	H	M	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	H	H	H
CO6	H	H	H	H	H	H	H	H	H	H	H	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct

1. **Continuous Assessment Test I,II**
2. **Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,**
3. **End SemesterExamination**

Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Mr.Y.BABU

CORE – IV: ANIMAL PHYSIOLOGY

SEMESTER: II **CODE: P20ZY204**

CREDITS: 5 **HOURS / WEEK:5**

1. COURSE OUTCOMES

On completion of this course, the students will be able to :

CO.NO	COURSE OUTCOME	LEVEL	UNIT
CO1	Analyze the structural and functional aspects of digestive and respiratory systems in mammals.	K4	I
CO2	Evaluate the function of the blood and the process of circulation in mammals.	K5	II
CO3	Interpret the mechanism of excretion, regulation of water balance, acid-base balance, electrolyte balance, thermoregulation and stress adaptations	K5	III
CO4	Examine the transmission of nerve impulses and physiology of muscle contraction	K4	IV
CO5	Asses the role of hormones in the coordination of activities in the biological systems	K5	V
CO6	Explain the reproductive processes and disorders of ovary in mammals	K5	V

2. SYLLABUS

Unit – I: DIGESTIVE & RESPIRATORY SYSTEM (15hrs)

Digestion-absorption- energy balance - BMR. **Respiratory system**: Internal and external respiration-Comparison of respiration in mammals -respiratory pigments-transport of gases - exchange of gases - neural and chemical regulation of respiration.

Unit – II : BLOOD AND CIRCULATION (15hrs)

Blood corpuscles - haemopoiesis and formed elements -plasma function-blood volume -blood volume regulation. **Cardiovascular System**: Anatomy of heart - myogenic heart - principle and significance of ECG - cardiac cycle - blood pressure and neural and chemical regulation.

Unit – III: EXCRETORY SYSTEM & THERMOREGULATION (15hrs)

Excretory system:kidney-urine formation- urine concentration-waste elimination-micturition-regulation of water balance - electrolyte balance- acid-base balance.
Thermoregulation: Comfort zone - body temperature - physical, chemical, neural regulation- acclimatization- stress adaptation.

Unit – IV NERVOUS AND MUSCULAR SYSTEMS AND SENSE ORGANS (15hrs)

Nervous system :Central and Peripheral nervous system - Neurons - action potential– transmission ofnerve impulse - neural control of muscle tone and posture.

Sense organs : Vision, hearing, gustation, olfaction and tactile.

Muscular system: Ultra structure of muscle - Physiology of muscle contraction

Unit – V :ENDOCRINE GLANDS (15hrs)

Principles of Hormone action -Pituitary, Thyroid, Adrenal and Parathyroid: Hormones - mechanism of action, functions and diseases. - Neuroendocrine regulation. Hormonal control of female reproductive cycle: Menstrual cycle -pregnancy- parturition – lactation.Disorders of Ovary: Polycystic Ovarian Syndrome.

*With reference to mammals

Topics for self study:

S.No	Topics	Web links
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:

Sherwood, L., Klandorf, H, and Yancey, P.H. Text Book of Animal Physiology 2008.Cengage Learning India Pvt., Ltd.

Hoar, W.S. General and Comparative Physiology,1968 Prentice Hall

Reference Books:

1. Hill R.W., Wyse G.A. and Anderson, M., Animal Physiology., 2nd Ed.,2008. Sinauer Associates, Inc Publisher, Massachusetts.
2 . Moyes, C.D. and Schulte, P.M. Principles of Animal Physiology. Pearson Education, 2007, Dorling Kindersley Publication. New Delhi.

3.Guyton, A.C. Textbook of Medical Physiology. 2000.W.B. Saunders Company, Philadelphia, London, Toronto and IgakuShoin/Saunders (Tokyo).

4.Prosser, C.L. Comparative Animal Physiology. 3rd Ed., 1973W.B. Saunders & Co. Philadelphia

Weblinks

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/animal-physiology

https://handwrittennotes.in/product/science-notes-anatomy-and-physiology-of-animal-anatomy-and-physiology/

https://nptel.ac.in/courses/102/104/102104042/

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomic level of Transaction
I	**DIGESTIVE & RESPIRATORY SYSTEM**		
1.1	Digestion of food and absorption	• Describe the process of digestion and absorption • Analyze the digestion & absorption of food	**K4**
1.2	Energy balance mechanism Intake of energy, Energy expenditure	• Illustrate the mechanism of energy balance • Categorize the energy expenditure in animals	**K4**
1.3	BMR	• Analyze the basal metabolic rate in various animals	**K4**
1.4	Internal and external respiration, Comparison of respiration in mammals	• Demonstrate internal and external respiration in mammals • Compare the mechanism of respiration in mammals	**K3**
1.5	Types of respiratory pigments	• Classify the respiratory pigments	**K4**

1.6	Transport and exchange of gaseous molecules Regulation (Neural, chemical)	• Analyse the transport of gaseous molecules • Explain the regulation of respiration	**K4**
II	**BLOOD AND CIRCULATION**		
2.1	Types of blood corpuscles, haemopoiesis	• Classify the blood corpuscles • Discuss the production of RBC	**K5**
2.2	Function of blood plasma	• List out the functions of blood plasma	**K5**
2.3	Blood volume and its regulation	• Examine blood volume and its regulation	**K4**
2.4	Heart – Anatomy	• Describe the structure of heart	**K2**
2.5	Myogenic heart, ECG	• Interpret the heart rate	**K5**
2.6	Cardiac cycle, blood pressure	• Infer the process of cardiac cycle • Measure the blood pressure	**K5**
2.7	Neural and chemical regulation	• Conclude the regulation of circulation	**K5**
III	**EXCRETORY SYSTEM & THERMOREGULATION**		
3.1	Kidney – anatomy	• Describe the structure of Kidney	**K2**
3.2	Formation and concentration of Urine	• Explain the process of urine formation in mammals	**K4**
3.3	Waste elimination, Micturition	• Interpret the process of micturition	**K5**
3.4	Water balance, Electrolyte, acid –base balance	• Relate water balance, Electrolyte, acid –base balance	**K2**
3.5	Thermoregulation: body temperature Regulation (physical, chemical, neural)	• Analyse the influence of body temperature in physiology of mammals • Explain different types of regulation inExcretion	**K5**
3.6	Acclimatization, stress adaptation	• Assess acclimatization due to temperature	**K5**
IV	**NERVOUS AND MUSCULAR SYSTEMS AND SENSE ORGANS**		

4.1	CNS, PNS : types of neuron	• List out the type of neurons	**K4**
4.2	Action potential, impulse transmission	• Analyze the transmission of nerve impulse	**K4**
4.3	Optic, auditory, gestation, Olfactory, tactile	• Explain the structure of sensory Organs • Analyse the functions of sensory organs	**K5**
4.4	Neural control of muscle tone, posture, muscle structure, Physiology of muscle contraction	• Identify and illustrate muscle tone and posture • Explain the physiology of muscle contraction	**K5**
V	**ENDOCRINE GLANDS**		
5.1	Pituitary, Thyroid, Adrenal, Parathyroid Action of hormones, functions and disorders	• Summarize the different types of endocrine glands • Justify "pituitary gland is the master gland" • Identify and Interpret the hormonal disorders	**K5**
5.2	Neuro endocrine regulation of hormones	• Explain the Neuro endocrine regulation	**K5**
5.3	Hormonal control of female reproductive cycle: Menstrual cycle, Ovulation, Pregnancy, Parturition	• Explain the hormonal control of the menstrual cycle • Discuss the process of ovulation, Pregnancy and Parturition	**K5**
5.4	Disorders of Ovary: PCO	• Explain the ovarian disorder, Polycystic Ovarian Syndrome	**K5**

4. Mapping Scheme for the PO, PSOs and COs

P19ZY204	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO 2	PSO3	PSO 4
CO1	H	M	M	H	H	-	-	M	-	H	H	-	-
CO2	H	-	M	L	L	-	-	-	-	H	H	-	-
CO3	H	M	M	L	L	-	-	-	-	H	H	-	-
CO4	H	M	M	L	L	-	-	-	-	H	H	-	-
CO5	M	M	M	L	L	-	-	-	-	H	H	-	-
CO6	H	M	M	L	L	-	-	-	-	H	H	-	-

L-Low **M-Moderate** **H- High**

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation** **3.End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Mr. JEREMIAH KIRUBANANTH

CORE – V: BIOCHEMISTRY

SEMESTER: II **COURSE CODE: P19ZY205**

CREDITS: 5 **HOURS / WEEK:5**

1. Course Outcomes

On completion of this course, the students will be able to :

CO.No.	COURSE OUTCOME	LEVEL	UNIT
CO1	Explain the basic concepts/functions of solutes, chemical bonding and organic compounds.	K2	I
CO2	Predict the structure of proteins and their biological active sites	K6	II
CO3	Assess quantitative and qualitative estimation of biomolecules	K5	III
CO4	Explain the importance of biochemical metabolism of carbohydrate	K5	IV
CO5	Evaluate the importance of biochemical metabolism of protein and lipid	K5	V
CO6	Analyze the importance of essential aminoacids	K4	V

2. A. Syllabus

Unit – I CHEMICAL BONDS, BUFFERS AND CARBOHYDRATES 15hrs

Chemical bonds and interaction: Hydrogen bond, ionic bond and covalent bonds - vanderwaals and hydrophobic interactions - Water as a solvent - **pH and buffers:** Acid-base reactions- dissociation constants (Ka) for weak acids and weak bases - role of buffers in biological systems. **Carbohydrates:** monosaccharides: linear and heterocyclic structure - conformational structure- isomers - epimers. Disaccharides - oligosaccharides - polysaccharides- Glycoproteins and glycolipids.

Unit – II PROTEINS AND LIPIDS 15hrs

Proteins: Primary structure–peptide bond. Secondary structure–αhelix -β pleated sheet and bends- Prediction of secondary structure: Ramachandran plot. T ertiary structure – Forces stabilizing tertiary structure - Domains and motifs. Quaternary structures-Molecular chaperones - prions. **Lipids:** Structure – Steroids – Cholesterol.

Unit – III ENZYMES 15hrs

Enzymes: Classification of enzymes - co-enzymes- iso-enzymes- ribozyme - abzymes. Enzyme specificity: Mode of action of enzymes - Formation of enzyme substrate complex. **Enzyme kinetics:** Equilibrium and steady - state assumptions - Michaelis - Menten equation - significance of Km Value- MM & amp; LB plots - Enzyme regulation

Unit – IV CARBOHYDRATE METABOLISM 15hrs

Carbohydrate metabolism: Glycolysis - Pentose phosphate pathway - citric acid cycle- oxidative phosphorylation. Gluconeogenesis - Cori cycle. Glycogen metabolism: Glycogenesis - Glycogenolysis - Adenylate cascade system- Regulation of glycogen synthesis – Intermediate metabolism.

Unit – V PROTEIN AND LIPID METABOLISM 15hrs

Metabolism of Proteins: Deamination, transamination and transdeamination. **Metabolism of lipids:** β oxidation – alpha oxidation - omega oxidation -synthesis of triacylglycerols - **Synthesis of essential amino acids:** methionine and valine - synthesis of purine and pyrimidine nucleotides.

B. Topics for Self –Study :

S.No.	Contents	Web Link
1.	Entropy	http://guweb2.gonzaga.edu/faculty/cronk/CHEM245pub/entropy.html
2.	Enthalpy	http://guweb2.gonzaga.edu/faculty/cronk/CHEM245pub/enthalpy.html
3.	Electron Transport Chain	https://microbenotes.com/electron-transport-chain-etc-components-and-steps/
4.	Action Potential	https://teachmephysiology.com/nervous-system/synapses/action-potential/
5.	Metabolic acidosis	https://litfl.com/metabolic-acidosis/

C. Text Books:

1. Cox M.M. and Nelson D.L. Lehninger's Principles of Biochemistry, 4th Ed., 2005 New York: W.H. Freeman

2. Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students, Revised Ed., 2001.

D. Reference Books:

1. Voet D. and Voet, J.G., Biochemistry, 4th Ed., 2011 John Wiley & Sons,

2. BergJ.M., Tymoczko J.L. and Stryer L. Biochemistry, 6th Ed., 2007 W.H Freeman and Company, New York.

3. Zubay G.L., Principles of Biochemistry, 2000Dubuque, Williams C, Brown Publishers.

4. Murray R.K., Granner D.K. and Mayer P.A., Harper`s Illustrated Biochemistry: A Lange Medical Book, 26th Ed., 2003 New Delhi, McGraw-Hill.

5. Bayens J.W. and Marek D, Medical Biochemistry, 2nd Ed., 2005 Elsevier.

6. Mathews C.K., Van holde, K.E. and AHERNK.G., Biochemistry, 3rd Ed., 2004 New Delhi, Pearson Education.

7. Elliott W. H. and Elliott D. C., Biochemistry and Molecular Biology, 3rd Ed., 2005 Oxford University Press, Indian Edition.

8. Devlin T. M., Text book of Biochemistry with Clinical Correlation, 2002 John Wiley & Sons.

9. Price N.C. and Stevens L., Fundamentals of Enzymology, 3rd Ed., 2006 Oxford University Press.

10. Conn E.E., Stump P.K., Bruening G. and DOI R.H., Outlines of Biochemistry, 5th Ed., 2007 John Wiley & Sons, Indian Edition.

E. Web Links:

https://nptel.ac.in/content/syllabus_pdf/104105076.pdf

https://www.classcentral.com/course/swayam-experimental-biochemistry-12909

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/ Section	Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomical level of Transaction
I	**CHEMICAL BONDS, BUFFERS & CARBOHYDRATES**		
1.1	**Chemical bonds and interaction:** Hydrogen bond, ionic bond and covalent bonds - vanderwaals and hydrophobic interactions - Water as a solvent	• Define interaction of atoms, ions and molecules in biochemical process	K1
1.2	**pH and buffers:** Acid-base reactions- dissociation constants (Ka) for weak acids and weak bases - role of buffers in biological systems.	• Demonstrate different acid base interaction and role of buffers in biological system	K2
1.3	**Carbohydrates**: monosaccharides: linear and heterocyclic structure - conformational structure- isomers - epimers. Disaccharides - oligosaccharides – polysaccharides - Glycoproteins and glycolipids.	• Interpret the structure and conformational changes of different carbohydrates	K2
II	• **PROTEINS & LIPIDS**		
2.1	**Proteins:** Primary structure–peptide	• Predict the	K6

	bond. Secondary structure–α helix -β pleated sheet and bends - Prediction of secondary structure: Ramachandran plot. Tertiary structure - Forces stabilizing tertiary structure - Domains and motifs. Quaternary structures-Molecular chaperones - prions.	conformational changes of protein structures	
2.2	**Lipids:** Structure – Steroids – Cholesterol.	• Explain the structure and properties of lipids	K2
III	• **ENZYMES**		
3.1	**Enzymes:** Classification of enzymes - co-enzymes- iso-enzymes- ribozyme - abzymes. Enzyme specificity: Mode of action of enzymes - Formation of enzyme substrate complex.	• Classify enzymes and their properties and Examine the interaction of enzyme substrates complex	K4
3.2	**Enzyme kinetics:** Equilibrium and steady-state assumptions- Michaelis -Menten equation-significance of Km Value- MM & LB plots - Enzyme regulation.	• Determine the chemical reaction catalyzed by enzymes.	K5
IV	• **CARBOHYDRATE METABOLISM**		
4.1	**Carbohydrate metabolism:** Glycolysis – Pentose phosphate pathway - citric acid cycle-oxidative phosphorylation. Gluconeogenesis - Cori cycle. Glycogen metabolism: Glycogenesis - Glycogenolysis - Adenylate cascade system- Regulation of glycogen synthesis – Intermediate metabolism.	• Explain the fundamental biochemical process that ensures constant supply of energy to living cells	K2
V	• **PROTEIN AND LIPID METABOLISM**		

5.1	**Metabolism of Proteins:** Deamination, transamination and trans-deamination.	• Determine the biochemical process responsible for the synthesis of proteins	K5
5.2	**Metabolism of lipids**: β oxidation – alpha oxidation - omega oxidation - synthesis of triacylglycerols -	• Determine the synthesis and degradation of lipids in cells, involving the breakdown or storage of fats for energy.	K5
5.3	**Synthesis of essential amino acids:** methionine and valine - synthesis of purine and pyrimidine nucleotides.	• Analyze the pathways involved in the synthesis of essential amino acids.	K4

4. Mapping Scheme for the PO, PSOs and Cos

P19ZY205	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H		L			M				L			M
CO2		M		M				H				M	
CO3	L				L				M				H
CO4			M					L			M		M
CO5	H				M		H			L			
CO6		M		H		L			M			H	

L - Low **M - Medium** **H - High**

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,**

3. End Semester Examination
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Mr.Y.BABU

ELECTIVE – II: IMMUNOLOGY/ ENDOCRINOLOGY

SEMESTER: II **COURSE CODE: P19ZY2:2/P19ZY2:A**

CREDITS : 4 **HOURS/ WEEK : 4**

1. COURSE OUTCOMES:

On completion of this course, the students will be able to:

CO.No.	COURSE OUTCOME	LEVEL	UNIT
CO1	Interpret the structure and functions of lymphoid organs.	K5	1
CO2	Explains the functions of Complements and its mechanism to form Membrane attack complex.	K5	II
CO3	Interpret the types and functions of MHC complex	K5	III
CO4	Explains about tumor antigens and its immune response.	K5	IV
CO5	Appraise the role of vaccines in treating diseases	K5	IV
CO6	Elaborate the importance of immunotechniques	K6	V

2. A. SYLLABUS

Unit – I IMMUNITY AND ITS TYPES 12hrs

Immunity: Innate and Acquired immunity- Ultra structure and functions of primary and secondary lymphoid organs. Cell types - origin and specific functions. Antigens and Immunogens - characteristics - epitopes. **Immunoglobulins:** 3D structure-classes- antigenic determinants- class switching-generation of antibody diversity.

Unit – II CELL MEDIATED IMMUNITY AND COMPLEMENTS PATHWAY 12hrs

Immune response: antigen recognition- processing and presentation-interaction of T and B cells – cell mediated and humoral immunity - cytokines and immune response – immunological memory – agglutination - antigen-antibody interactions – complements - classical and alternative pathway and immunological significance.

Unit – III MAJOR HISTO COMPATIBILITY COMPLEX AND TRANSPLANTATION IMMUNOLOGY

12hrs

Major Histocompatibility Complex: structure of MHC molecules –types - MHC and antigens presentation. **Transplantation immunology:** HLA typing-immunology of graft rejection- Hypersensitivity reactions -immunotolerance and autoimmune diseases

Unit – IV CANCER IMMUNOLOGY AND IMMUNODEFICIENCY DISEASES 12hrs

Immunology of cancer: tumor antigens- immune response to tumor antigens - immuno therapy.
Primary immunodeficiency: SCID **-Secondary immunodeficiency:** Immunological abnormalities associated with AIDS – CD4 and CD8 cells. **Vaccines: Types,** Vaccination schedule - Polysaccharide vaccines-toxoids- vaccines from recombinants vectors- DNA vaccines.

Unit – V IMMUNOTECHNIQUES 12hrs

Immunotechniques: Precipitin reactions: immunodiffusion and immunoelectrophoresis RIA–ELISA -Western Blotting Complement fixation -Flow cytometry - Monoclonal antibody production -Principles of immunohistochemistry- Fluorescent immunoassay (FIA).

B. Topics for self-study:

No	TOPICS FOR SELF-STUDY	WEB-LINKS
1.	Lymphocyte antigen Receptor	https://www.sciencedirect.com/topics/neuroscience/lymphocyte-antigen-receptor
2.	. Generation of T cell receptor ligands.	https://www.pnas.org/content/109/45/E3111
3.	The immune response in health and disease.	https://www.sciencedirect.com/science/article/abs/pii/S0950355205800033
4.	Immunity at mucosal surfaces.	https://www.sciencedirect.com/science/article/pii/B9780128119242000067

C. Text Book

Roitt, I.M., and Delves, P.J. Roitt's Essential Immunology. 10th Ed., Oxford: Blackwell Science, 2000

D. Reference Books:

1. Goldsby, R.A., Kindt, T. J. and Osborne, B. A. Kuby's Immunology. 5th Ed., WH Freeman & Co., 2003.

2. Abbas, A.K. and Lichtman, A.H. Cellular and Molecular Immunology. 6th Ed., Saunders Elsevier, 2007.

3. Janeway, C. Immunobiology. 5th Ed., Garland Publications, 2001.

4. Benjamin, E., Richard, C., and Sunshine, G. Immunology: A Short Course. 4th Ed., John Wiley, New York, 2000.

5. Tizard, I.R. Immunology 4th Ed., Thomson, Singapore, 2004.

6. Chakravarty, A.K. Immunology and Immunotechnology. Oxford University Press. New Delhi, 2000.

E. Weblinks

https://www.niaid.nih.gov/research/immune-system-overview

https://www.cell.com/immunity/comments/S1074-7613(00)80641-X

https://www.ncbi.nlm.nih.gov/books/NBK27156/

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/Section	**Course Contents**	**Specific Learning Outcomes (SLO)**	**Highest Bloom's taxonomy level of transaction**
1	**IMMUNITY AND ITS TYPES**		
1.1	Immunity –Introduction-History of Immunology Types- Innate immunity- barriers-First line of defense, Second line of defense, Third line of defense	• 1.Explain immunity and its types	K5
	Acquired immunity – Natural active, Artificial active, Natural passive, Artificial passive	• 2.Distinguish the types of barriers and the types of defenses	K4
1.2	Ultra-structure and functions of primary and secondary lymphoid organs	• Explain the structure of lymphoid organs and its functions.	K 5
1.2	Cell types Lymphoid & Myeloid lineage Functions of Lymphoid & Myeloid lineage	• 1.Explain the types of cell lineages	K 5
		• 2.Compare the types of lymphoid and myeloid lineages	K 5
	Antigens and	• Classify the types of antigens	K

1.3	Immunogens Types of antigens Properties of antigens Difference between antigens & immunogens Epitopes		4
		• Compare the difference between antigens and immunogens.	K 4 K 5
		• Explain the properties of antigens • Distinguish the epitopes and its types.	K 4
1.4	Immunoglobulins- types- Ig G,A,M,D,E Class switching	• Interpret the basic structure of immunoglobulin	K 5
		• Explain the types of Immunoglobulins structure and its functions	K 6
1.5	Generation of Antibody diversity Heavy chain & light chain rearrangements	• Analyse the process of class switching and its types	K 4
		• Elaborate the mechanism of generation of antibody diversity and Heavy chain & light chain rearrangements	K 6
II	• **CELL MEDIATED IMMUNITY AND COMPLEMENTS PATHWAY**		
2.1	Immune response antigen recognition- processing and presentation. Antigen processing and presenting cells –MHC Class I & MHC Class II	• Analyse the immune response	K 4
		• Elaborate the process of antigen recognition and processing and presentation.	K 6
		• Explain the antigen processing and presentation	K 5
2.2	Interaction of T and B cells T Helper cells & T cytotoxic cells in antigen processing	• ompare the process of interaction of T cells and B cells in antigen processing.	K 5

2.3	Cell mediated and humoral immunity Cell mediated immunity- cytotoxic cells – Dendritic cells, TC CD8 cells,ADCC- perforated channels- antigen degradation. Humoral immunity- Activation of B cells-	• xplain the process of cell mediated immunity in antigen degradation.	K 5
		• • laborate the process of humoral immunity and activation of B cells.	K 6
2.4	Cytokines and immune response Types and its functions	• Categorise the types of cytokines .	K 4
		• • Explain the process of immune response induced by cytokines	K 5
2.5	Immunological memory Clonal expansion & clonal differentiation of B cells	• Explain the process of immunological memory	K 5
		• Elaborate the process of Clonal expansion & clonal differentiation of B cells	K 6
2.5	Agglutination reaction Antigen antibody interactions	• 1.Explain the process of agglutination reaction	K 5
		• 2.Examine the process of antigen antibody interaction	K 4
2.6	Complements - classical and alternative pathway- Opsonisation - immunological significance.	• Explain the process of activation of complement pathway	K 5
		• • Explain the classical pathway and its functions	K 5
		• Describe the alternative pathway and its functions	
III	• **MAJOR HISTOCOMPATIBILITY COMPLEX AND TRANSPLANTATION IMMUNOLOGY**		

3.1	Major Histocompatibility Complex Structure of MHC molecules Types – Class I, Class II, Class III	• xplain the structure and functions of Major histocompatibility complex.	K 5
		• lassify and determine the types of MHC involved in antigen processing and presentation	K 5
	MHC and antigens presentation APCs and Antigens processing & presentation	• xplain the process of antigen processing and presentation to T helper cells through MHC cmplex	K 5
3.2	Transplantation immunology HLA – introduction	• lassify the types of grafts used in transplantation processes	K 4
	HLA typing Immunology of graft rejection –Kidney transplantation & Eye transplantation	• xplain the process of HLA typing	K 5
		• xplain the process of graft rejection in kidney transplantation and in eye transplantation	
3.3	Hypersensitivity reactions Types- I.II,III,IV,V	• istinguish the types of hypersensitivity reaction and the diseases associated to it.	K4
		• ist out the various pharmacological mediators involved in hypersensitivity reaction.	K4
3.4	Immunotolerance Central tolerance Peripheral tolerance	• lassify the types of immunological tolerance	K 4
3.5	Autoimmune diseases Types- systemic & organ specific	• ompile the significance of auto immune diseases.	K 6
		• ist out the types of auto immune diseases	

IV	• **CANCER IMMUNOLOGY AND IMMUNODEFICIENCY DISEASES**		
4.1	Immunology of cancer Tumor antigens-Types 1. Tumor antigens recognised by T-lymphocytes 2. Tumor antigens identified by xenogeneic antibodies	• ist out the types of tumor antigens	K 4
		• nterpret the significance of umor antigens recognised by xenogeneic antibodies	K 5
4.2	Immune response to tumor antigensImmune response by T & B cells	• xplain the mechanism of cell mediated and humoral immune response to tumor cells.	K 5
4.3	Immuno therapy. Active immunization Passive therapy	• nterpret the process of immune therapy to tumors.	K 5
		• ompare the types of immune therapy to tumors.	K 5
4.4	Cytokines	• xplain the role of cytokines in immune response.	K 5
		• ist out the types of cytokines.	K 4
4.5	Primary immunodeficiency SCID- symptoms & deficiency of immune cells	• efine SCID	K 5
		• • xplain the types of immunodeficiency	K 5
		• nalyse the symptoms of primary immunodeficiency	K 6
4.6	Secondary immunodeficiency Immunological abnormalities	• Elaborate the process of secondary immunodeficiency with immunological abnormalities	K 6

	associated with AIDS – CD4 and CD8 cells Symptoms- Immune cells Vaccines Vaccination schedule	• Interpret the role of CD4 and CD8 cells in AIDS	K5
4.5	Polysaccharide vaccines Types – Hib, Meningococcal vaccines Outer membrane protein vaccines Conjugate vaccines Toxoids Tetanus Toxoids	• • Explain the Types of vaccines	K 5
	Vaccines from recombinants vectors Multivalent subunit vaccine DNA Vaccines DNA as adjuvant - Mucosal adjuvant	• Explain the role of polysaccharide vaccines, • Conjugate vaccines, toxoid vaccines and recombinant vaccines.	K 5
		• • Compare the role of the different vaccines and its significance	K 5
V	• **IMMUNOTECHNIQUES**		
5.1	Immunotechniques Introduction to immunotechniques Precipitin reactions Agglutination reaction Agglutination Vs. Precipitation reactions	• Compare the process of precipitin reactions and agglutination reactions.	K 5
		• Explain the mechanism of antigen antibody interaction	K 5

5.2	Immunodiffusion techniques Ouchterlony Gel Diffusion	• Explain the significance of immunodiffusion techniques.	K 5
5.3	Immunoelectrophoresis-Two step double diffusion technique.	• List out its applications.	K 4
		• Describe the importance of immunoelectrophoresis techniques.	K 3
5.4	RIA Principle & Applications	• Elaborate the principle and applications of RIA	K 5
5.5	ELISA Types – Direct, Indirect, Sandwich	• Define ELISA	K 3
		• Describe the types of ELISA and its role in detecting the presence of antigen and antibody	K 3
5.6	Western blotting Principle & Applications	• Explain the principle and applications of Western blotting technique	K 6
5.7	Complement fixation Antibody detection test – Principle & Applications	• Elaborate the process of complement fixation in antibody detection	K 5
		• List out the applications of Complement fixation test	K 4
5.8	Flow cytometry Principle, Procedure & Applications	• Explain the process of flow cytometry and list out its applications.	K 5
5.9	Monoclonal antibody production Establishment of Hybridoma Production of monoclonal antibodies	• Elaborate the process of production of monoclonal antibody	K 6
		• Explain the process of establishment of Hybridoma • Define the media used for Hybrdoma technology	K 5
		• Analyse the role of immunohistochemistry in antibody detection	K 4

5.10	FIA -Fluorescent immunoassay	• Explain the principle and applications of Fluorescent immunoassay	K 5

4. Mapping Scheme for the PO, PSOs and COs

P19ZY2:1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO3	PSO4
CO1	H	L	M	M	H	H	M	H	M	M	H	H	H
CO2	H	M	M	M	H	H	M	H	M	M	H	H	H
CO3	H	H	H	H	H	H	H	H	M	M	H	H	H
CO4	H	-	H	H	H	H	H	H	M	M	H	H	H
CO5	H	-	H	H	H	H	H	H	M	M	H	H	H
CO6	H	-	H	M	H	H	H	H	M	M	H	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,** **3. End SemesterExamination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.J.JOONU

ELECTIVE – III: BIOSTATISTICS

SEMESTER: II **COURSE CODE: P19ZY2:3**

CREDITS : 4 **HOURS /WEEK: 4**

1. Course Outcomes:

On completion of this course, the students will be able to :

CO. NO	COURSE OUTCOME	LEVEL	UNIT
CO1	Explain the methods of data collection in biological research	K5	I
CO2	Compare and interpret results by chi-square and ANOVA among two or more populations	K4	II
CO3	Compare and interpret the various distribution methods	K4,K3	III
CO4	Examine the hypotheses and compare the data using student 't' test.	K4	IV
CO5	Verify and evaluate the basic concepts of statistics using SPSS.	K6,K4	V
CO6	Analyse the statistical inference by correlation and regression	K4	V

2. A.SYLLABUS

Unit - I : COLLECTION OF DATA (12 Hrs)

Introduction to Biostatistics – Applications and Role of biostatistics in modern research –Concepts of biostatistics - Collection of Data: Primary and Secondary data – Classification and tabulation of Data – Diagrammatic and Graphical Representation – Frequency Distribution.

Unit – II: MEASURES OF CENTRAL TENDENCY AND DISPERSION (12 Hrs)

Measures of Central tendency (Mean, Median and Mode) – Measures of Dispersion (Range, SD, Quartile deviation, Mean deviation, Variance, Coefficient of variance, Standard Error).

Unit- III: PROBABILITY THEORY AND DISTRIBUTIONS (12Hrs)

Probability: Concepts of probability, Types of Probability-Measures of probability-Theorems of probability (Addition and Multiplication)–Probability distributions –Binomial, Poisson, Normal distribution and their applications.

Unit – IV : SAMPLING METHODS AND ANALYSIS (12 Hrs)

Inference about population – sampling methods – Hypothesis testing –'t' test: One sample t test, Properties and applications. Chi-square test for goodness of fit-Statistical software and handling (SPSS/R-Programming), MS - Excel

Unit – V : STATISTICAL ANALYSIS (12 Hrs)

Analysis of Variance (ANOVA) - One way ANOVA-Two way ANOVA – Correlation – Types, Methods -Graphic, mathematical (Karl Pearson's correlation Coefficient)–Regression- Types (Simple, linear and total regression), Regression equation and regression line.

B. Topics for Self- Study:

S.No.	Topics	Web Links
1.	**Sampling methods**	https://towardsdatascience.com/sampling-techniques-a4e34111d808
2.	**Probability**	https://www.statisticshowto.com/probability-sampling/ https://research-methodology.net/sampling-in-primary-data-collection/probability-sampling/
3.	**New statistical packages**	https://en.wikipedia.org/wiki/List_of_statistical_software
4.	**Statistical distributions**	http://www.stat.rice.edu/~dobelman/textfiles/DistributionsHandbook.pdf

C.Text books:

An Introduction to Biostatistics, Gurumani.N Second Revised Edition,2008 www. MJP publishers, Chennai,

Palanichamy S and M. Manoharan,- Statistical methods for Biologists, , Paramount Publications, 2009

Pranab Kumar Banerjee Revised Edition, Introduction to Biostatistics, S. Chand Publishers, 2011

D. **Reference Books:**

McCleery, R.H. and WATT, T.A., Introduction to Statistics for Biology, 3rd Ed., 2007 Chapman & Hall/CRC,

Gupta S P, Statistical Methods S.Chand & Sons, 2008.
Zar, J.H, Biostatistical analysis – Prentice Hall Inc., New Jersey, USA, 1974.

E. Web links

https://statisticsbyjim.com/basics/measures-central-tendency-mean-median-mode/
https://www.surveysystem.com/correlation.htm
https://www.statisticshowto.com/probability-and-statistics/regression-analysis/
https://www.statisticshowto.com/probability-and-statistics/chi-square/

3. **SPECIFIC LEARNING OUTCOMES (SLO):**

S.No	Course Content	Learning outcome	Highest Blooms Taxonomic Level of Transaction
1	**Collection of data**		
1.1	Collection of data	• 1.Explain the collection of data • 2. Classify the data.	K2 K3
1.2	Graphical representation	• Compare and Interpret the data using graphs	K4 K2
1.3	Frequency distribution	• Construct the diagram/graph using the data	K5
II	**Measures of Central tendency**		
2.1	Measures of Central tendency-Mean	• Examine the length or width of the given molluscan shell and calculate the mean value	K3
52.2	Measures of Central tendency-Median	• Justify the length or width of the given molluscan shell and calculate the mean value	K4
2.3	Measures of Central tendency-Mode	• Justify the length or width of the given molluscan shell and calculate the mean value	K4
2.4	Measures of Dispersion	• Justify the length or width of the given molluscan shell and calculate the mean value	K4

2.5	Probability & Types	• Assess the degree of uncertainity numerically using probability	K6
2.6	Chi square test	• Find out degree of discrepancy between observed and expected frequency using the chi square test .	K1
III	**STASTICAL Distributions**		
3.1	Binomial Distribution	• Examine the statistical data using binomial distribution	K4
3.2	Poisson Distribution	• Analyse the statistical quality of the data using Poisson distribution	K4
3.3	Normal Distribution	• Design the statistical quality control experiment using normal distribution	K5
IV	**SAMPLING METHODS**		
4.1	Sampling methods	• Catogorise the different types of sampling methods	K4
4.2	Student's t-Test	• Verify the test the significance of a single mean when the population variance is unknown	K6
V	**STATISTICAL ANALYSIS**		
5.1	ANOVA	• Analyse the significance of differences in means and the variance by using ANOVA method	K3
5.2	Correlation	• Compare two different types of data using correlation analysis	K4
5.3	Regression	• Examine the average between two or more variables.	K4
5.4	Applications of SPSS package	• Analyse the data using SPSS software	K4

4. Mapping of COs and POs

P19ZY2:3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO3	PSO4

CO1	H	M	H	H	L	M	-	-	L	H	L	H	H
CO2	H	M	H	H	L	M	-	-	L	H	L	H	L
CO3	H	-	M	M	-	M	-	-	-	L	L	H	L
CO4	H	M	M	M	-	M	-	-	-	L	L	H	L
CO5	H	-	M	M	-	M	-	-	-	L	-	H	L
CO6	H	M	M	H	-	M	-	-	-	L	-	H	L

L-Low **M-Moderate** **H- High**

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.SUSAN.G.SUGANYA

CORE PRACTICAL – III : LAB IN ANIMAL PHYSIOLOGY AND IMMUNOLOGY/ ENDOCRINOLOGY

SEMESTER: II **COURSE CODE: P19ZY2P3**

CREDITS: 3 **NO OF HOURS PER WEEK: 5**

1. COURSE OUTCOMES

On completion of this course, the students will be able to :

CO.No.	COURSE OUTCOME	LEVEL	PRACTICALS
CO1	Apply the physiological concepts in experiments	K3	**I**
CO2	Interpret the results in physiological experiments.	K5	**I**
CO3	Identify the tissues of different endocrine organs	K3	**I**
CO4	Apply the immunological techniques in biology	K3	**II**
CO5	Analyze the various immunological disorders.	K4	**II**
CO6	Identify the tissues of lymphoid organs and Lymphocytes	K3	**II**

2. A.SYLLABUS

I ANIMAL PHYSIOLOGY **(40 Hrs)**

1. Survey of digestive enzymes in Cockroach (Invertase, Amylase, Maltase, Protease and Lipase)
2. The rate of oxygen consumption in fish with reference to body weight.
3. Rate of salt loss and salt gain in crab.
4. Estimation of urea in the blood and urine by DAM method.
5. Effect of Humulin on blood glucose level (Demonstration)
6. ECG (Demonstration).
7. **Prepared Slides:** T.S of endocrine organs: Pituitary, thyroid, parathyroid, pancreas, adrenal, ovary and testis.

II IMMUNOLOGY **(35 Hrs)**

1. Differential counting of WBCs.
2. Blood grouping and Rh factor analysis.
3. Quantitative estimation of Thyroid hormone by ELISA (Demonstration).
4. Double immune-diffusion
5. WIDAL test
6. **Prepared Slides:** T.S of lymphoid organs: Thymus, Bone marrow, lymph node , spleen, T cells and B cells.

B. Topics for Self-Study :

S.No	Topics	Web links
1	Osmoionic regulation in Tilapia fish	https://www.slideshare.net/mndp_slide/osmo-regulation-in-fish-by-mndp-poonia
2.	Analysis of heat shock response	https://www.cell.com/molecular-cell/pdf/S1097-2765(16)00136-2.pdf
3.	Immunoelectrophoresis	https://www2.slideshare.net/SaajidaSultaana/immunoelectrophoresis-169939054?from_action=save
4.	Immuno precipitation	https://www2.slideshare.net/masumaaktersani5/immunoprecipitation-84426921
5.	Monoclonal antibodies production	https://www2.slideshare.net/SrilaxmiMenon/monoclonal-antibody-production-and-hybridoma-technology

C. Text books

1. Ghai. C.L, A Textbook of Practical Physiology, 6th Edition,2005, Jaypee Brothers, Medical Publishers, New Delhi.
2. Rajan. S and Selvi Christy. R, Experimental procedures in Life Sciences,1st Edition 2010, Anjanaa Book House, Chennai.

D. Weblinks: https://laney.edu/rebecca_bailey/wp-content/uploads/sites/10/2017/07/Human-Physiology-Lab-Exercises-update-2017.pdf

3. SPECIFIC LEARNING OUTCOMES (SLO)

Experiment	Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomic level of Transaction
I	**ANIMAL PHYSIOLOGY**		
1.	Survey of digestive enzymes in Cockroach (Invertase, Amylase, Maltase, Protease and Lipase)	• Examine the digestive system present in the Cockroach • Analyse the digestive enzymes present in Cockroach	**K4**

2.	Rate of oxygen consumption in fish with reference to body weight.	• Apply the concepts of respiration in fish. • Evaluate the rate of oxygen consumption in fish • Interpret the results with reference to body weight.	**K5**
3.	Rate of salt loss and salt gain in crab**.**	• Apply the concepts of osmo-ionic regulation in crab • Analyse the rate of salt loss and salt gain in different media	**K4**
4.	Estimation of urea in the blood and urine(DAM method)	• Compare the quantity of urea present in the blood and urine • Evaluate the normal level of urea in the samples. • Analyze the results and predict the diseases.	**K5**
5.	Effect of Humulin on blood glucose level (Demo)	• Estimate the blood glucose level with the effect of humulin	**K5**
6.	ECG (Demo)	• Interpret and read the ECG graph of a human heart. • Assess the heart rate of a human being.	**K5**
7.	**Slides:** T.S of endocrine organs: Pituitary, thyroid, parathyroid, pancreas, adrenal, ovary and testis.	• Identify the tissues of different endocrine organs • Distinguish the cells of various endocrine organs	**K4**
II	**IMMUNOLOGY**		
1.	Differential counting of WBCs.	• Identify the different types of WBCs in the blood smear. • Distinguish the types of WBCs by the structure of nucleus.	**K4**
2.	Blood grouping and Rh factor analysis.	• Apply the concepts of multiple allele to find out the blood group. • Identify the blood group and Rh factor.	**K3**
3.	Quantitative estimation of Thyroid hormone by ELISA(Demo)	• Estimate Thyroid hormones by immunological techniques.	**K5**
4.	Double immune-diffusion	• Demonstrate the immunological technique Double immune diffusion	**K2**
5.	WIDAL test	• Detect typhoid by Widal test	**K5**

6.	**Slides:** T.S of lymphoid organs: Thymus, Bone marrow, lymph node , spleen, T cells and B cells	• Identify the tissues of lymphoid organs • Distinguish the cells of lymphoid organs.	**K3**

4. Mapping Scheme for the PO, PSOs and COs

P19ZY2P3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	H	H	H	H	M	H	-	H	H	M	M
CO2	H	M	H	H	H	H	M	H	-	H	H	M	M
CO3	H	M	H	H	H	H	M	H	-	H	H	M	M
CO4	H	M	H	H	H	H	M	H	-	H	H	M	M
CO5	H	M	H	H	H	H	M	H	-	H	H	M	M
CO6	H	M	H	H	H	M	M	H	-	H	H	M	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation.** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.PRISCILLA SURESH

CORE PRACTICAL - IV: LAB IN BIOCHEMISTRY

SEMESTER: II **CODE: P19ZY2P4**
CREDITS: 3 **HOURS / WEEK: 5**

1. COURSE OUTCOMES:

On completion of this course, the students will be able to :

CO. No	COURSE OUTCOMES	LEVEL	EXPERIMENTS
CO1	Evaluate the experiments based on biochemical calculations.	K5	1
CO2	Design & prepare the Acetate & Phosphate buffers.	K6	3
CO3	Evaluate the acid-base titration for pKa determination.	K5	3
CO4	Develop knowledge in structure, reactions and energy metabolism of the cellular biomolecules.	K6	4,5
CO5	Categorize & classify the micro molecules by TLC method	K5	8
CO6	Classify & separate the amino acids by Paper Chromatography method.	K5	9

2. A.SYLLABUS

BIOCHEMISTRY **(75 Hrs)**

1. Preparation of solutions: i) Molarity ii) Normality iii) Percentage solution
2. Calculation of moles, millimoles and nanomoles
3. Basic and Standardization procedures

i) Preparation and testing of buffers: Acetate and Phosphate buffers.
ii) Acid-base titration and determination of pKa value.
iii) Measuring pH of different solutions.

4. Quantitative estimation of reducing sugars by Anthrone method.
5. Quantitative estimation of amino acids by ninhydrin method.
6. Quantitative estimation of protein by Lowry *et al.* method.
7. Quantitative estimation of nucleic acids.
8. Separation of micromolecules by Thin layer Chromatography: Sugars and drugs
9. Separation of micromolecules by Paper chromatography: Amino acids.

B. Topics for self-study:

NO	TOPICS FOR SELF-STUDY	WEB-LINKS
1.	Estimation of Reducing Sugar by Dinitro	https://www.researchgate.net/publication/306034920_Laboratory_Manual_of_Biochemistry

	Salicylic Method	
2.	Determination of Micro nutrients by colorimetric method	https://www.researchgate.net/publication/306034920_Laboratory_Manual_of_Biochemistry
3.	Estimation of Total soluble solids	https://www.researchgate.net/publication/306034920_Laboratory_Manual_of_Biochemistry
4.	Estimation of Total Phenolic compounds	https://www.researchgate.net/publication/306034920_Laboratory_Manual_of_Biochemistry
5.	Estimation of Flavanols	https://www.researchgate.net/publication/306034920_Laboratory_Manual_of_Biochemistry

C. Text Book:

1. Laboratory Manual in Biochemistry: J.Jayaraman. Published by Wiley Eastern. 1981.

D. Reference Book:

1. Fundamentals of Biochemistry: A Practical Approach .Naren Kumar Dutta – 2005
2. Experimental Approaches in Biochemistry and Molecular Biology Henry M. Zeidan, William V. Dashek - 199

E. Web links:

https://biolympiads.com/wp-content/uploads/2014/08/metodich_1.pdf

https://courses.lumenlearning.com/introchem/chapter/acid-base-titrations/

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit /Section	Course Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomic level of Transaction
	BIOCHEMISTRY		
1	Preparation of solutions: i) Molarityii) Normality iii) Percentage solution	• Construct the experiments based on biochemical calculations.	K3
2.	Calculation of moles, millimoles and nanomoles	• Construct the experiments based on moles, millimoles and nanomoles.	K3
3	Basic and Standardization procedures	•	
3.1	i) Preparation and testing of buffers: Acetate and Phosphate buffers.	• Apply the procedure to prepare the acetate & phosphate buffers.	K3
3.2	ii) Acid-base titration and determination of pKa value.	• Evaluate the acid-base titration for pka determination.	K5
3.3	iii) Measuring pH of different solutions.	• Evaluate ph of different solutions	K5
4.	Quantitative estimation of reducing sugars by Anthrone method.	• Appraise the amount of reducing sugars in the biological samples. • Appraise the amount of reducing sugar in clinical samples	K5 K5
5.	Quantitative estimation of amino acids by ninhydrin method.	• Evaluate the amount of amino acids in the biological samples. • Appraise the amount of reducing sugar in clinical samples	K5 K5
6.	Quantitative estimation of protein by Lowry et al. method.	• Evaluate the amount of protein in the biological samples • Appraise the amount of protein in clinical samples	K5 K5
7.	Quantitative estimation of	• Evaluate the amount	K5

	nucleic acids.	of nucleic acidsin the biological samples. • Appraise the amount of nucleic acid in clinical samples	K5
8.	Separation of micro molecules by Thin layer Chromatography: Sugars and drugs	• Categorize & classify the micro molecules by tlc method.	K4
9.	Separation of micro molecules by Paper chromatography: Amino acids	• Classify & separate the amino acids by paper chromatography method.	K4

4. Mapping Scheme for the PO, PSOs and COs

P19ZY2P4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO3	PSO4
CO1	H	L	H	H	H	M	L	M	M	M	L	H	H
CO2	H	L	H	M	H	M	M	M	M	L	L	H	H
CO3	H	L	H	M	H	H	M	M	M	L	L	H	H
CO4	H	M	H	H	H	H	M	M	L	M	M	H	H
CO5	H	L	H	H	H	H	M	M	L	L	L	H	H
CO6	H	L	H	H	H	H	M	M	L	L	L	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation.** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.J.JOONU

CORE –VI: ENVIRONMENTAL BIOLOGY

SEMESTER: III **COURSE CODE: P19ZY306**

CREDITS : 5 **HOURS / WEEK: 5**

1. COURSE OUTCOMES

On completion of this course, the students will be able to:

CO.No	COURSE OUTCOMES	LEVEL	UNIT
CO1	Analyse the interrelation between abiotic and biotic environment and scope of Ecology	K4	I
CO2	Explain the characteristics of ecosystem.	K5	II
CO3	Explain the characteristics of population, Niche, Niche parameter.	K4	III
CO4	Compare ecological succession, equivalents and indicators.	K4	IV
CO5	Classify freshwater and marine habitats. List the characters of terrestrial habitat.	K2	V
CO6	Discuss the importance of biodiversity and its conservation.	K6	V

2. A.SYLLABUS

UNIT-I : ENVIRONMENTAL FACTORS & ECOSYSTEM (15 Hrs)

Importance and scope of ecology **–Environmental factors:** light – temperature – humidity – edaphic (soil) and biotic factors. Ecosystems: Characteristics of ecosystems - food chain – herbivorous and detritus food chains and food web - bio-magnification - Energy flow in an ecosystem– productivity - trophic levels.

Unit – II : POPULATION ECOLOGY (15 Hrs)

Population Ecology: Definition, Characteristics of Population: Density - Natality–Mortality– Age distribution – Growth form-Population Equilibrium – Biotic potential – Carrying capacity – Dispersal – Dispersion – Population fluctuations – Population regulation – r and K strategists. Niche concept – Types of niches: Spatial, Trophic and Multidimensional – Niche parameters: Form, Position and Width – Niche Partitioning - Realized and Fundamental Niche.

Unit – III : COMMUNITY ECOLOGY (15Hrs)

Community Ecology: Characteristics of a Community - Ecological succession–Primary andSecondary succession –Natural and man-influenced succession - Hydrarch and Xerarch - Ecotone and Edge effect - Ecological equivalents - Ecotypes and Ecophenes - Ecological indicators.

Unit – IV : HABITAT ECOLOGY (15 Hrs)

Habitat Ecology: Characteristics and types of fresh water and estuarine habitat. Marine habitat: Characteristics and types – Ecology of benthic zone, intertidal zone and deep sea.

Physico -chemical characteristics of terrestrial habitat – Tundra, Forest, Desert and mountain biomes - Biogeographical zones of India.

Unit-V : BIODIVERSITY AND ITS CONSERVATION (15 Hrs)

Biodiversity and its conservation-global environmental change – biodiversity-status, monitoring and documentation-Megadiversity and hotspots - biodiversity management approaches. Conservation biology: Principles of conservation, major approaches to management, Indian initiatives for conservation (Project Tiger, Project Elephant Biosphere reserves).IUCN, Red Listed animals, Endangerd animals, WWF and Wildlife Institutes in India.

B.Topics for Self-Study:

S.NO	Advanced Topics	Web links/Reference Book
1	Biogeochemical cycles, N C P	https://byjus.com/biology/biogeochemical-cycles/#:~:text=Biogeochemical%20cycles%20are%20basically%20divided,Phosphorus%2C%20Rock%20cycle%2C%20etc.
2	Ecotoxicology	https://library.um.edu.mo/ebooks/b28113652.pdf
3	Waste Treatment Technology	https://www.pseau.org/outils/ouvrages/wrc_wastewater_treatment_technologies_a_basic_guide_2016.pdf
4	Environmental Laws	https://en.wikipedia.org/wiki/Environmental_law
5	Types of biodiversity	https://www.vedantu.com/biology/biodiversity

C. Text Book

Odum, E.P. and Barrett, G.W. Fundamental of Ecology. 5th Ed.,2005 Cengage Learning India. New Delhi,

D. Reference Books:

1. PeterJ.R., Stephan, L.W., PauleH., Ceche S. and Bevlerly, M. Ecology,2008 Cengage learning India, New Delhi,
2. Wright, R.T., Environmental Science, 10th Ed., 2008 Pearson Education, New Delhi,
3. Smith T.M. and SmithR.L.,Elements of Ecology, 6th Ed., 2008 Pearson Education, New Delhi,
4. Kormondy E.J, Concepts of Ecology, 4th Ed.,1996 PHI Cengage Learning India, New Delhi,
5. Turk A. and Turk J., Environmental Science., 4th Ed., 1993 Saunders,
   Primark R.B., A Primer of Conservation Biology, 2nd Ed., 2000 Sinauer Associates

E. **Weblinks**

https://nptel.ac.in/courses/127/106/127106004/

3.SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Course Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomic levels of Transaction
I	**ENVIRONMENTAL FACTORS AND ECOSYSTEM**		
1.1	Abiotic factors: Light, temperature, soil, water	• List out the abiotic factors	K4
		• Identify the role of light,soil,water ect...	K3
1.2	Biotic factors: symbiosis, commensalism, mutualism,predation, parasitism and competition	• Explain the animal interaction	K4
		• Justify the animal behaviours	K5
1.3	Biogeochemical cycles: Nitrogen, phosphorous.	• Examine the Biogeochemical cycles • Analyse the importance of chemical cycles	K4 K5
1.4	Trophic levels: Food chain, Food web	• Assess the food habits	K5
1.5	Ecological Pyramids: Pyramid of biomass, number, and energy.	• Measure the classification of energy	K4
		• Measure the energy level	K5
		• Analyze the level of consumers	K5
II	**POPULATION ECOLOGY**		
2.1	Population : Definition - natality- mortality- age pyramids- population equilibrium- fluctuation- regulation	• Measure and classify the population characteristics	K5

2.2	Carrying capacity	• Explain the concept of CC	K5
2.3	Niche concept	• Classify the Niche concept	K4
3	**COMMUNITY ECOLOGY**		
3.1	**Community Ecology:** Types of community - characteristics of community – stratification – Carrying capacity	• Assess the types of community – characteristics	K5
3.2	Ecotone edge effect - ecological Niche - ecological succession.	• Compare and contrast the each aspect	K5
3.3	Ecosystem: Structure of Pond ecosystem.	• Analyze the pond ecosystem..	K5
3.4	Ecological indicators.	• explain the different level indicators • survey the flora and fauna communities	K5
IV	**HABITAT ECOLOGY**		
4.1	Fresh water characteristics	• Estimate the distribution level	K5
4.2	Estuary	• Survey the flora and fauna communities	K4
4.3	Marine	• Survey the flora and fauna communities	K4
4.4	Concepts and levels of biodiversity	• Elaborate the concept and	K5

		levels of biodiversity	
V	**BIODIVERSITY AND CONSERVATION**		
5.1	Biodiversity	• Elaborate the concept and levels of biodiversity	K3
5.2	– biodiversity-status, monitoring and documentation	• Elaborate and to develop the documentation skill	K3
5.3	Conservation biology	• Plan to conserve the endangered species	K6
5.4	Project Tiger, Project Elephant Biosphere reserves	• Plan to conserve the key stone species	K3
5.5	IUCN, Red Listed animals, Endangerd animals, WWF and Wildlife Institutes in India	• Take part in conservatory aspects	K4

4. Mapping Scheme for the PO, PSOs and COs

P15ZY306	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	H	H	H	-	H	-	H	H
CO2	H	H	H	H	H	M	H	H	-	H	-	H	M
CO3	H	H	H	H	H	-	H	H	-	H	-	H	-
CO4	H	H	H	H	H	H	H	H	H	H	-	H	H
CO5	H	H	M	H	H	H	M	H	H	H	-	-	H
CO6	H	H	H	H	H	M	H	H	-	H	-	H	H

L-Low **M-Moderate** **H- High**

5. COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.KAMALA KANNAN

CORE-VII: DEVELOPMENTAL BIOLOGY

SEMESTER: III **COURSE CODE: P19ZY307**

CREDITS : 5 **HOURS / WEEK: 5**

1. COURSE OUTCOMES

On completion of this course, the students will be able to :

CO.No	COURSE OUTCOMES	LEVEL	UNIT
CO1	Illustrate the basic principles of growth and development in animals.	K2	I
CO2	Interpret the axis and pattern formation in Drosophila.	K5	II
CO3	Explain the environmental regulation of animal development	K5	III
CO4	Examine the metamorphosis in amphibia and regeneration in salamander.	K4	IV
CO5	Justify the concepts of organiser in determining the fate of developing embryos	K5	IV
CO6	Identify the role of genes in the embryonic development.	K3	V

2. A. SYLLABUS

Unit – I : FERTILIZATION IN MAMMALS (15 Hrs)

Introduction to Developmental Biology- spermatogenesis and oogenesis in mammals - **Fertilization in mammals:** translocation and capacitation of sperm - cell surface interactions between egg and sperm -gamete fusion- cleavage and formation of blastula- gastrulation and formation of germ layers.

Unit – II : CELL DIFFERENTIATION (15 Hrs)

Concepts of induction, competence, totipotency, cell specification, commitment, determination and morphogenetic gradients - cell lineages – cell differentiation and cell aggregation in *Dictyostelium* -axis and pattern formation in drosophila – gradient and polarity.

Unit – III : ORGANOGENESIS (15 Hrs)

Organogenesis: Development and differentiation in *Caenorhabditis elegans*–development of vertebrate eye – development of tetrapod limb. **Environmental regulation of animal development:** developmental symbiosis - nutritional and seasonal polyphenism. **Abnormal development:** Teratoma and teratogens.

Unit – IV : ORGANISER (15 Hrs)

Organiser: Spemann's experiment- functions of organiser–mechanism of noggin, chordin, Follistatin,BMP4, Wnt, FGF and retinoic acid for the action of organiser. **Metamorphosisin**

amphibia: morphological changes associated with metamorphosis. **Regeneration:** Mechanism of regeneration in salamander. **Ageing:** The biology of senescence.

Unit – V :GENES IN DEVELOPMENT (15 Hrs)

Genes in Gonad development: Function of SF1, WNT4, SRY, SOX genes. **Genes in embryonic development:** Role of Homeobox genes in Drosophila and Hox genes in Mouse. Concepts of GeneKnock out, Genomic imprinting and Genomic equivalence.

B.Topics for Self-Study :

S.No	Topics	Web links
1.	Zebrafish early and Late development	https://embryology.med.unsw.edu.au/embryology/index.php/Zebrafish_Development
2.	Development of central nervous system in vertebrates	https://www.britannica.com/science/nervous-system/The-vertebrate-system
3.	Germ cell specification and migration	https://link.springer.com/article/10.1007/s12522-014-0184-2
4.	Model organism in developmental Biology	https://blog.addgene.org/plasmids-101-five-popular-model-organisms
5.	Medical implications of Developmental Biology.	https://www2.slideshare.net/AYSHA007/medical-implication-of-developmental-biology?from_action=save

C. Text Books

1. Gilbert B.F., Developmental Biology, 8th Ed.,2006 Sinaur Associates Inc. Publishers, Sunderland, Massachusetts, USA,
2. Veer Bala Rastogi, Chordate Embryology,2016, Kedar Nath Ram Nath

D. Reference Books:

1. Wolpert L, Principles of Development, 2nd Ed., 2002 Oxford University Press,
2. Twyman R.M. Developmental Biology, 2008 Viva, New Delhi,
3. BalinskyB.I., An Introduction to Embryology, 5th Ed., 2004 Thomas Asia Pvt. Ltd.,
4. Russo V.E.A, BrodyS., Cove D and Ottolenghi S, Development: The Molecular Genetic Approach, 1992 Springer Verlag, Berlin,
5. Rao.V, Developmental Biology: A Modern Synthesis, 1994 Oxford IBH New Delh

E. Web Links:

https://nptel.ac.in/courses/102/106/102106084/

http://mcb.berkeley.edu/courses/mcb141/lecturetopics/Levine/engrailed.pdf

https://plato.stanford.edu/entries/biology-developmental/notes.html

3 SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	Contents	Learning Outcomes	Highest Blooms Taxonomic levels of Transaction
I	**FERTILIZATION IN MAMMALS**		
1.1	Introduction: Spermatogenesis and Oogenesis	• Recall the formation of gametes • Relate the structure and functions of egg and ova	**K1**
1.2	Fertilization in mammals Translocation and Capacitation of sperm, cell surface interactions between egg and sperm , gamete fusion	• Explain the process of fertilization in mammals. • Examine cell surface interactions	**K4**
1.3	Cleavage formation of blastula, gastrulation, formation of germ layers	• Explain the process of cleavage • Evaluate the formation of blastula and gastrula	**K5**
II	**CELL DIFFERENTIATION**		
2.1	Concepts of induction, competence, totipotency, cell specification, commitment	• Relate induction, competence and totipotency • Illustrate cell specification and commitment	**K2**
2.2	Cell lineages, cell differentiation and cell aggregation in *Dictyostelium*	• Determine cell lineages • Summarize the cell differentiation and aggregation in *Dictyostelium*	**K5**
2.3	Axis and pattern formation in Drosophila, Gradient and polarity	• Examine Axis and pattern formation in Drosophila • Illustrate Gradient and Polarity	**K4**

III	**ORGANOGENESIS**		
3.1	**Organogenesis** Development and differentiation in *Caenorhabditis elegans* Development of vertebrate eye, Development of tetrapod limb	• Explain the development and differentiation of *Caenorhabditis elegans* • Influence of organizer in the development of vertebrate eye • Examine the Development of tetrapod limb	**K5**
3.2	**Environmental regulation of animal development** Developmental symbiosis -nutritional and seasonal polyphenism	• Explain the Environmental regulation of animal development • Illustrate Developmental Symbiosis • Relate the importance of nutritional and seasonal polyphenism	**K5**
3.3	**Abnormal development:** Teratoma and teratogens.	• Analyse the causes of Teratoma • Classify the types of teratogens	**K4**
IV	**ORGANISER**		
4.1	**Organiser** Spemann's experiment, mechanism of noggin, chordin, Follistatin	• Interpret Spemann's experiment of organiser • Examine the mechanism of noggin, chordin, Follistatin through Spemann's experiment	**K4**
4.2	BMP4, Wnt, FGF and retinoic acid for the action of organizer	• Distinguish BMP4, Wnt, FGF and retinoic acid for the action of organizer	**K4**
4.3	**Metamorphosis in amphibian** Morphological changes associated with metamorphosis	• Asses the morphological changes during metamorphosis in Amphibia.	**K3**
4.4	**Regeneration:** Mechanism of regeneration in salamander.	• Explain the Mechanism of regeneration in salamander	**K5**
4.5	**Ageing:** The biology of senescence	• Categorize the agents of senescence • Explain in detail the biology of aging	**K5**
V	**GENES IN DEVELOPMENT**		

5.1	**Genes in Gonad development** Function of SF1, WNT4, SRY, SOX genes	• Justify the function of Genes in Gonad development • Evaluate the function of SF1, WNT4, SRY, SOX genes in development	**K5**
5.2	**Genes in embryonic development** Role of Homeobox genes in Drosophila and Hox genes in Mouse	• Compare the role of Homebox genes in Drosophila and Hox genes in mouse	**K4**
5.3	Concepts of Gene Knock out, Genomic imprinting and Genomic equivalence.	• Summarise the Concepts of Gene Knock out, Genomic imprinting and Genomic equivalence • Illustrate the concepts of Gene Knockout • Explain the importance of Genomic imprinting and Genomic equivalence	**K2**

4. Mapping Scheme for the PO, PSOs and COs Course code: P19ZY307

P19ZY307	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M	M	-	H	H	H	H	H	H	-
CO2	H	H	H	M	M	-	H	H	H	H	H	H	-
CO3	H	H	H	M	M	-	H	H	H	H	H	H	-
CO4	H	H	H	M	M	-	H	H	H	H	H	H	-
CO5	H	H	H	M	M	-	H	H	H	H	H	H	-
CO6	H	H	H	M	M	-	H	H	H	H	H	H	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I,II **2.Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.PRISCILLA SURESH

CORE-VIII: GENETICS

SEMESTER: III **COURSE CODE: P19ZY308**
CREDITS : 4 **HOURS PER WEEK: 5**

1. COURSE OUTCOMES:
On completion of this course, the students will be able to :

CO. No	COURSE OUTCOMES	LEVEL	UNIT
CO1	Interpret the Mendelian law of inheritance.	K4	I
CO2	Compare the nuclear and maternal inheritance of genes	K4	II
CO3	Elaborate the environmental effects and gene expression	K6	III
CO4	Analyze the concepts of Microbial genetics	K4	IV
CO5	Discuss the perception of Evolutionary and population genetics	K6	V
CO6	Assess the importance of human genetics and its related disorders	K5	V

2. A. SYLLABUS

Unit I : MENDELIAN GENETICS (15 Hrs)

Mendelian Genetics: Mendelian laws of inheritance–**Classical Genetics:** Linkage–crossing over–types and mechanics – chromosome mapping –Heterogamatic and Homogametic – Haplodiploidy-Mosaics and Gynandromorphs. Human Y chromosome - evolution, structure, molecular organization and its role in sex determination- Dosage compensation.

Unit-II :MATERNAL INHERITANCE AND GENE EXPRESSION (15 Hrs)

Extranuclear inheritance and maternal effects: Organelle heredity (mitochondria) - Infectious heredity (Cytoplasmic inheritance) in symbionts (Paramecium and Drosophila). **Maternal inheritance:** Ephestia pigmentation and snail coiling. **Environmental effects and gene expression**– Phenocopies- Twin studies and IQ- Concordance – Discordance- Penetrance and expressivity.

Unit-III :MICROBIAL GENETICS: (15 Hrs)

Microbial Genetics: Evidence of genetic materials in Bacteria. **Bacterial transformation:** molecular mechanism- mapping by transformation. **Bacterial conjugation:** insertion of F into the bacterial chromosome- Hfr transfer- recombination in recipient cells. Transduction: DNA transfer by means of transduction- cotransduction and linkage. **Specialized transducing particles:** Phagemids, Cosmids -characteristics- role as cloning vectors.

Unit-IV : EVOLUTIONARY POPULATION GENETICS: (15 Hrs)

Evolutionary Genetics: Genetics of races and species formation–genetic load–geneticpolymorphism – X inactivation – genomic imprinting.

Population Genetics: Gene pool and gene frequencies–equilibrium of gene frequencies–Hardy-weinberg equilibrium – changes in gene frequencies- factors affecting Hardy-weinberg equilibrium.

Unit-V : HUMAN GENETICS (15 Hrs)

Human Genetics: Pedigree construction, inheritance patterns (autosomal, sex -linked,sex -limited and sex-influenced)- Gene Mutation and Chromosomal aberrations - Inborn errors of metabolism in man -Haemoglobin disorders- Chromosomal syndromes– sickle cell anemia and thalassemia - Genetic counselling.

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B. Topics for Self-Study:

S.No.	Topics	Web Links
1	Genetic Analysis of Inbreeding	https://www.ucl.ac.uk/~ucbhdjm/courses/b242/InbrDrift/InbrDrift.html
2	Parental Imprinting	http://atlasgeneticsoncology.org/Educ/GenomImprintID30027ES.html
3	Mutant Genes in Bacteria	https://eujournal.org/index.php/esj/article/view/2518
4	Amniocentesis and Chorionic Biopsy	https://www.cdc.gov/mmwr/preview/mmwrhtml/00038393.htm#:~:text=CVS%20utilizes%20either%20a%20catheter,surrounds%20the%20fetus%20is%20removed

C. Text Book:

1. Gardner E.J, Simmons, M.J. and Snustad D.P, Principles of Genetics, 7th Ed., 2007 John Wiley India,

D. Reference Books:

1. WilliamK.S. and CummingsM. Concepts of Genetics, 7th Ed.,2011 Pearson Education Inc, Dorling Kindersley Publication,
2. SnustadD.P. and SimmonsM.J. Genetics, VI Ed., 2012 John Wiley & Sons, Singapore,
3. SudberyP, Human Molecular Genetics, 2nd Ed.,2009 Dorling Kindersley (India) Pvt. Ltd.,
4. Nancy T and TrempyJ, Fundamental Bacterial Genetics, 2nd Ed.,2006 Malden MA; Blackwell Science,
5. Stent G.S. and Calendar R. Molecular Genetics: An Introductory Narrative, 2nd Ed., 2004 CBS Publishers and Distributers, New Delhi,
6. Klug W.S. and CummingsM.R. Concepts of Genetics. 7th Ed., 2003 Pearson Education,
7. RusselP.J. Genetics: A Molecular Approach, 2nd Ed., 2006 Pearson Education,
8. MaloyS.R.,Cronan, J.E. and Freifelder, D. Microbial Genetics 2nd Ed., 2008 Narosa Publishing House, New Delhi,
9. Pasternak, J.J. An Introduction to Molecular Human Genetics.2000 Fritzgerald Science Press, Bethesda

10. Hancock, J.T. Molecular Genetics.2008 New Delhi.

E. Web Links:

https://nptel.ac.in/courses/102/104/102104052/

https://onlinecourses.swayam2.ac.in/cec20_bt03/preview

3. Specific Learning Outcomes (SLO)

Unit	Course Contents	Specific Learning Outcomes (SLO)	ghest Blooms Taxonomic level of Transaction
I	**MENDELIAN GENETICS**		
1.1	Mendelian genetics	• Define the laws of inheritance	**K1**
1.2	Classical genetics	• Elaborate the concepts of linkage and crossing over	**K6**
1.3	Chromosome mapping	• Explain the types and significance of chromosome mapping	**K6**
1.4	Human chromosomes	• Assess the evolutionary concepts of chromosome	**K5**
		• Determine the molecular level of organization	**K5**
		• Identify the concept behind sex determination and dose compensation	**K3**
II	**MATERNAL INHERITANCE AND GENE EXPRESSION**		
2.1	Extranuclear inheritance and maternal effects	• Explain the heredity of mitochondria	**K5**
		• Classify the various Cytoplasmic inheritance in Symbionts	**K2**
2.2	Maternal inheritance	• Elaborate about the Ephesian pigmentation	**K6**
		• explain about the coiling process occur in snail	
2.3	Environmental effects & gene expression	• Interpret the role of gene expression in phenotypes.	**K5**
III	**MICROBIAL GENETICS**		
3.1	Microbial Genetics	• Analyse the importance of genetic materials in bacteria	**K5**
3.2	Bacterial transformation	• Explain about molecular mechanism • by transformation technique	**K2**
3.3	Bacterial Conjugation	• Explain about the Hfr transfer and recombination technique in bacterial cells	**K5**
		• Elaborate the process of DNA transduction and linkages	**K6**
3.4	Transducting particles	• Categorize and explain the specialized transducting vectors	**K4**
		• Explain the role of cloning vectors	**K5**
IV	**EVOLUTIONARY POPULATION GENETICS**		
4.1	Evolutionary Genetics	• Assess the genetics of races and species formation	**K5**
		• Explain the genetic polymorphism	**K5**

		• Elaborate the process of genomic imprinting	**K5**
4.2	Population Genetics	• Summarise the concepts of gene pool and gene frequencies	**K2**
		• Evaluate Hardy Weinberg equilibrium	**K5**
		• Estimate changes occur due to gene frequencies	**K5**
		• Analyze the factors affecting Hardy-Weinberg equilibrium.	**K2**
V	**HUMAN GENETICS**		
5	Human Genetics	• Evaluate the inheritance pattern through pedigree chart	**K5**
		• Explain the concept of gene mutations with examples	**K5**
		• Explain the concept of Human karyotype preparation	**K2**
		• Find out the various chromosomal syndromes in mam	**K1**

4 Mapping Scheme for the PO, PSOs and COs

P19ZY308	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	H	H	M	M	M	M	M	H	M	H	M	H
CO2	H	M	H	H	H	H	M	H	M	H	H	H	H
CO3	H	H	H	H	H	-	H	H	H	H	H	H	H
CO4	H	H	H	H	H	-	H	H	M	H	H	H	H
CO5	H	H	H	H	M	H	-	H	H	H	H	H	H
CO6	H	H	H	H	H	H	H	H	H	H	H	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II **2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Mr.JEREMIAH KIRUBANANTH

CORE IX: RESEARCH METHODOLOGY AND BIOTECHNIQUES

SEMESTER: III **COURSE CODE : P19ZY309**

CREDIT: 4 **HOURS / WEEK: 5**

1. **COURSE OUTCOMES:**

On completion of this course, the students will be able to:

CO.No	COURSEOUTCOMES	LEVEL	UNIT
CO1	Apply the Statistical principles and skills in biological research	**K3**	**I**
CO2	Analyse, review and assess critically scientific hypotheses and theories using scientific evidence and information	**K6,K4**	**II**
CO3	Design to the learning process of how to write thesis and how to publish papers in various journals	**K5**	**II**
CO4	Investigate the various chemical compounds using chromatographic technique	**K4**	**III**
CO5	Explain the principles and applications of spectrophotometry and electrophoresis	**K4**	**IV**
CO6	Select and use the animal cell culture technique	**K3**	**V**

2. A.SYLLABUS

Unit – I : COMPONENTS OF RESEARCH (15 hrs)

Research: Objectives–types–significance-Components of research- Research process - **Research Design:** need-features of a good design–concepts-principles of Experimental design.Selectionand Defining of a research problem- **Sources and retrieval of information:** journals, monographs, books –computer aided searches - Offline and Online journals -search engines- Formulating a research Hypothesis-

Unit – II : THESIS WRITING (15 hrs)

Thesis writing: format of thesis- preparation of manuscript and editing - forms of presentation ofresults-components of Discussion- citing the references - Research papers for publication-writing a research proposal-Impact factor-citation index- manuscript preparation-IPR and patenting.

Unit – III : CHROMATOGRAPHY & CENTRIFUGATION (15 hrs)

Chromatography: Principle and methodology of column, ion exchange and affinity chromatography -GLC and HPLC-**Centrifugation:** Differential and gradient centrifugation-Ultra centrifuge-Principles and applications of Autoradiography and X-ray crystallography.

Unit –IV : SPECTROPHOTOMETRY & ELELCTROPHORESIS (15 hrs)

Spectrophotometry: Principle, methodology and applications of Atomic absorbance spectrophotometer, Flame Photometer, UV-VIS spectrophotometer, Nuclear magnetic resonance spectrometry (NMR).**Electrophoresis:** Principle, types, procedure and applications. Cell lines-cell lines culture.

Unit – V : ANIMAL CELL CULTURE TECHNIQUES (15 hrs)

Animal Cell culture Techniques: Design and functioning of tissue culture laboratory- Cell proliferation measurements- Cell viability testing- Culture media preparation. Types of culture: -Flask, Test tube, Organ and Embryo culture. Protoplast culture. Stem cell culture. Cryopreservation for cells, Tissues and organisms. Germplasm storage: Cryobank - Pollen bank and sperm bank.

B. Topics for self study:

S.No.	Topics	Web links
1.	Patenting	https://www.government.nl/topics/intellectual-property/question-and-answer/what-are-the-criteria-for-patenting-my-invention
2.	Crystallography	https://en.wikipedia.org/wiki/Crystallography
3.	cell line culture	file:///C:/Users/Dell/Downloads/2015_Bookmatter_TheImpactOfFoodBioactivesOnHea.pdf
4	Stem cell culture	https://www.creative-bioarray.com/support/stem-cell-culture-guide.htm https://microbenotes.com/stem-cells/

C. Text Book :

Kothari, C.R. Research Methodology: Methods and Techniques. 2nd Ed.,2004 New Age International Publishers, New Delhi,

D. Reference Books:

1. Pingoud, A. Biochemical Methods. 2003 Wiley-VCH,
2. Venn, R.F. Principles and Practice of Bioanalysis. 2003 Taylor & Francis,
3. Holme, D.J. and Peck, H. Analytical Biochemistry. 3rd Ed.,1998 Pearson Education,
4. Wilson, K. and Walker, J. Practical Biochemistry: Principles and Techniques. 5th Ed.,2000 Cambridge University Press,

5. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed.,2010 Cambridge University Press,
6. Holmes, D., Moody, P., Dine, D., Moody, P. andHolmes, D.S. Research Methods for the Biosciences. 2006 Oxford University Press, New Delhi,
7. Ramadass, P. and Wilson Aruni, A. Research and Writing-across the Disciplines.2009 MJP Publishers, Chennai.

E. Web Links:

https://www.mayoclinic.org/tests-procedures/in-vitro-fertilization/about/pac-

https://microbenotes.com/polyacrylamide-gel-electrophoresis-page/

https://assets.thermofisher.com/TFS-Assets/LSG/manuals/D21111.pdf

https://atecentral.net/downloads/1163/Basics_of_Cell_Culture_students_manualv7.pdf

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ section	Course content	Learning outcome	Highest Blooms Taxonomic Level of Transaction
I	**COMPONENTS OF RESEARCH**		
1.1	Introduction	• Define research	K6
1.2	Types of research	• Classify and explain the types of research	K4
1.3	Sources & retrieval of information	• Compare the various methods in reteriving of information for research	K4
1.4	Research design	• Discuss in detail the important concepts related to research design	K6
		• Explain briefly the parts of research design	K2
II	**THESIS WRITING**		
2.1	Thesis writing	• Explain the structure of thesis	K4
2.2	Impact factor & citation index	• Compare and interpret the research publications	K4
2.3	IPR& Patent	• Create the IPR & patent for your indegeneous research findings	K5
III	**CHROMATOGRAPHY & CENTRIFUGATION**		

3.1	Chromatography – Column, Ion exchange, Affinity	• Classify the types of chromatography	K3
3.2	Centrifugation – GLC,HPLC,Differential &gradient, Ultra centrifuge	• Explain the principle of various centrifugation methods. • Justify centrifugation is a best separation method	K4 K6
3.3	Autoradiography	• Classify and compare the components present in the biological material using autoradiography	K4
3.4	X-ray crystallography	• Predict the molecular structure using X - ray crystallography	K5
IV	**SPECTROPHOTOMETRY & ELELCTROPHORESIS**		
4.1	Spectrophotometry Atomic absorbance Flame photometer UV-VIS NMR	• Analyse and categorise the various molecules present in the biological sample using Spectrophotometry,Atomicabsorbance,Flame photometer • UV-VIS, NMR	K4
4.2	Electrophoresis	• Use the electrophoresis technique to separate the molecules based on MW	K3
4.3	Cell Line-culture	• How will you formulate a animal cell line culture for your research	K5
V	**ANIMAL CELL CULTURE TECHNIQUES**		
5.1	Design and functioning of tissue culture laboratory	• Plan and Construct a tissue culture laboratory based on your need	K5
5.2	Cell viability testing	• Verify the cell viability using cell viability testing method	K6
5.3	Culture media preparation	• Compose various culture medias according to your need	K5

5.4	Types of culture: Protoplast culture Stem cell culture Cryo preservation for cells	• Construct a protoplast culture laboratory and the use of stem cell culture method	K5
5.5	Germplasm storage Cryobank, Pollenbank	• Formulate and explain the germ plasm storage technique. • Construct a cryobank or pollen bank in your area	K5 K5

4. **Mapping of COS and POs**

P19ZY309	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO3	PSO4
CO1	H	H	H	H	H	H	-	-	-	H	M	H	M
CO2	H	H	H	H	H	H	-	-	-	H	M	H	M
CO3	M	M	M	H	H	H	-	-	-	M	-	H	M
CO4	M	M	L	H	H	H	-	-	-	-	M	H	H
CO5	M	M	L	H	H	H	-	-	--	-	M	H	H
CO6	M	M	L	M	H	H	-	-	-	-	M	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.SUSAN.G.SUGANYA

CORE PRACTICAL - V: LAB IN ENVIRONMENTAL

BIOLOGY, DEVELOPMENTAL BIOLOGY AND GENETICS

SEMESTER III **CODE: P19ZY3P5**

CREDITS: 4 **HOURS / WEEK: 6**

1. COURSE OUTCOMES:

On completion of this course, the students will be able to:

CO.No.	COURSE OUTCOMES	LEVEL	PRACTICALS
CO1	Qualitatively and qualitatively estimate different ecological parameters.	K3	I
CO2	Interpret the results of qualitative and quantitative estimations	K5	I
CO3	Identify the embryonic development of chick and frog	K3	I
CO4	Apply the immunological techniques in biology	K3	II
CO5	Examine different genetic traits and chromosomal aberrations in Human being	K4	III
CO6	Prepare a pedigree chart for chromosomal traits	K3	III

2. A.SYLLABUS

I ENVIRONMENTAL BIOLOGY **(35 hrs)**

Different ecological parameters.

Spatial variations of dissolved oxygen concentration in water and percentage saturation

Estimation of Dissolved free carbon dioxide

Estimation of Nitrates

Estimation of Total Hardness

Estimation of Total Alkalinity

Estimation of Total Phosphates

II DEVELOPMENTAL BIOLOGY **(20 hrs)**

Observation of sperms in Bull's semen

Observation of blastoderm in chick embryo

Slides: Whole mount of early hours of chick embryo development (24 hrs, 48 hrs, 72 and 96 hours).Yolk Plug stage, neural plate, neural fold and neural tube of frog

III GENETICS **(20 hrs)**

Pedigree analysis

Study of various genetic traits in Human being

Preparation of Human karyotype

Identification of syndromes

Study of sex chromatin in human buccal smear.

B. Topics for Self study

S.No	Topics	Web links
1	BOD, COD	Biochemical Oxygen Demand - an overview | ScienceDirect Topics , What is Chemical Oxygen Demand (COD)? - Definition from Corrosionpedia
2.	Histology techniques	Histological Techniques
3.	Embryonic stem cells	Embryonic Stem Cells | stemcells.nih.gov
4.	Gene manipulation	Genetic Manipulation: Definition, Pros & Cons - Video & Lesson Transcript | Study.com
5.	NGS technology	Next-Generation Sequencing (NGS) | Explore the technology (illumina.com)

C. Web Links:

http://tumkuruniversity.ac.in/wp-content/uploads/2014/11/ENV-SCIENCE.pdf

file:///C:/Users/dell/Downloads/BIO_150L_new_course.pdf

https://bangaloreuniversity.ac.in/wp-content/uploads/2018/08/Syllabus-B.Sc_.-Genetics-2018.pdf

3. SPECIFIC LEARNING OUTCOME

Unit/Section	Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomic level of Transaction
I	**ENVIRONMENTAL BIOLOGY**		
1.1	Spatial variations of dissolved oxygen concentration in water and percentage saturation	• Evaluate the oxygen saturation according to space	**K3**
1.2	Estimation of Dissolved free carbon dioxide Estimation of Nitrates Estimation of Total Hardness Estimation of Total Alkalinity Estimation of Total Phosphates	• Qualitatively estimate different water quality parameters.	**K4**
II	**DEVELOPMENTAL BIOLOGY**		
2.1	Observation of sperms in Bull's semen	• Examine the motility and fertility of bull semen	**K5**
2.2	Observation of blastoderm in chick embryo **Slides**: Whole mount of early hours of chick embryo development (24 hrs, 48 hrs, 72 and 96 hours).	• Observe and identify different embryonic stages of chick	**K4**
2.3	Yolk Plug stage, neural plate, neural fold and neural tube of frog	• Observe and identify different embryonic stagesand metamorphosis of frog	**K3**
III	**GENETICS**		
3.1	Pedigree analysis	Classify the traits	**K4**
3.2	Study of various genetic traits in Human being	Categorize the allosomal and autosomal characters	**K4**

3.3	Preparation of Human karyotype	Infer the chromosomal aberrations	**K4**
3.4	Identification of syndromes	Discuss the cause of the human syndromes	**K6**
3.5	Study of sex chromatin in human buccal smear	classify the gender using the methodology	**K4**

4. Mapping Scheme for the PO, PSOs and COs

P15ZY3P5	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	H	H	M	M	M	L	M	M	H	H	H
CO2	H	M	M	H	M	M	M	M	H	M	-	L	H
CO3	H	H	M	M	L	M	M	L	M	-	H	M	H
CO4	H	M	H	M	H	H	L	M	H	M	H	-	H
CO5	H	H	M	H	H	M	-	L	M	-	-	-	H
CO6	H	H	M	H	H	M	M	L	M	L	H	M	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2.Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation, Sample analysis, Record** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Mr.JEREMIAH KIRUBANANTH

ELECTIVE - IV: ANIMAL BIOTECHNOLOGY/GENOMICS AND PROTEOMICS

SEMESTER: III **COURSE CODE: P19ZY3:4/P19ZY3:A**

CREDIT: 4 **HOURS / WEEK : 4**

1. Course Outcomes

On completion of this course, the students will be able to :

CO.No.	COUORSE OUTCOMES	LEVEL	UNIT
CO1	Discuss fundamental concepts and tools used in recombinant DNA technology	K6	I
CO2	Develop methodology to establish animal cell culture	K6	II
CO3	Create transgenic animal breeds.	K6	III
CO4	Create the importance of genetic engineering in transgenic animal production	K6	IV
CO5	Build techniques in medical biotechnology for the production of therapeutic proteins, vaccines and targeted gene therapies	K6	V
CO6	Design public policy, bio safety, and intellectual property rights issues related to animal biotechnology.	K6	V

2. A. SYLLABUS

Unit – I : RECOMBINANT DNA TECHNOLOGY (15 hrs)

Introduction- brief history -Recombinant DNA technology: Steps in rDNA technology. Molecular tools: restriction enzymes and DNA manipulative enzymes – gene cloning vectors: plasmids, phagemids, cosmids, bacteriophages, artificial chromosomes (BACs, PACs, YACs, MACs, and HACs)- shuttle vectors, prokaryotic and eukaryotic expression vectors - specialized vectors for expression of foreign gene.

Unit – II : GENOMIC LIBRARIES (15 hrs)

Construction of cDNA - genomic DNA libraries – preparation of radioactive and nonradioactive probes-screening of libraries using oligo probes and antibodies-Nucleic acid amplification and its application in medicine– DNA sequencing- site directed mutagenesis and protein engineering.

Unit – III : GENETIC ENGINEERING IN ANIMALS (15 hrs)

Genetic engineering in animals: methods of transferring genes in to animals oocytes, eggs embryos and specific tissues (physical chemical and biological methods)- cell lines and their applications-transgenic animals (mice, cow, sheep and insects) -Gene silencing.

Unit – IV : MEDICAL BIOTECHNOLOGY (15 hrs)

Medical biotechnology: Animal biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins - gene therapy- cloning. Human Genome project: objectives, strategies and progress.

Unit – V : BIOTECHNOLOGICAL APPLICATIONS (15 hrs)

Bioremediation - Types : Insitu – Exsitu – Stratergy – Applications and Advantages – Bio sensors, bioleaching, biochips and biofuels. Applications of Probiotics – Forensic Biotechnology: DNA finger printing. Environmental applications of biotechnology–Biosafety and Bioethics.

B. Topics for self study:

S.No.	Contents	Web Link
1.	CRISPR	https://www.livescience.com/58790-crispr-explained.html
2.	Lentivirus	https://old.abmgood.com/marketing/knowledge_base/The_Lentivirus_System.php
3.	Personalised medicines	https://healthitanalytics.com/features/what-are-precision-medicine-and-personalized-medicine
4.	*Bioreactors in Tissue Engineering*	https://www.oulu.fi/spareparts/ebook_topics_in_t_e_vol2/abstracts/korossis_0102.pdf
5.	Biosimilar	https://www.dovepress.com/biosimilars-an-overview-peer-reviewed-article-BS

C. Text Book:-

1. Glick, B.R. and Pasternak, J.J. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 3rd Ed., 2007 ASM Press, Washington. Indian Reprint, 2007.

D. Reference Books:-

1. Primrose, S.B. and Twyman, R.M. Principles of Gene Manipulation and Ge nomics. 2006, Blackwell Scientific Publications.

2. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. Introduction to Genetic Analysis. 8th Ed., 2005 W. H. Freeman and Company, New York.

3. Brown, T.A. Gene Cloning and DNA Analysis: An Introduction. 5th Ed., 2006 Blackwell Publishing.

4. Watson, J.D., Gilman, M., Witkowski, J. and Zoller, M. Recombinant DNA. 2nd Ed., 1992 W. H. Freeman, Scientific American Books, New York.

5. Winnacker, E.L. From Genes to Clones: Introduction to Gene Technology. 2003 Panima Publishing Corporation, New Delhi.

6. Tamarin, R.H. Principles of Genetics. 7th Ed., 2006 Tata-McGraw Hill Publishing Company Ltd., New Delhi.

7. Kreuzer, H. and Massey, A. Recombinant DNA and Biotechnology. 2nd Ed., 2001 ASM Press, Washington.

E. Web Links:

http://ecoursesonline.iasri.res.in/course/view.php?id=350

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit / Section	Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomical level of Transaction
I	**RECOMBINANT DNA TECHNOLOGY**		
1.1	Brief introduction to Animal Biotechnology and History	• Define the basics of animal biotechnology	K2
1.2	**Recombinant DNA technology:** Steps in rDNA technology	• Illustrate basic steps in rDNA technology	K6
1.3	Restriction enzymes and DNA manipulative enzymes	• Define the role of restriction enzymes in DNA manipulation	K1
1.4	Plasmids, phagemids, cosmids, bacteriophages, artificial chromosomes (BACs, PACs, YACs, MACs, and HACs) - shuttle vectors, prokaryotic and eukaryotic expression vectors	• Construct novel vectors for efficient gene transfer	K6
1.5	Specialized vectors for expression of foreign gene		K6
II	**GENOMIC LIBRARIES**		
2.1	Genomic DNA libraries	• Explain expression of genomic libraries in host cells	K5
2.2	Preparation of radioactive and nonradioactive probes		
2.3	Screening of libraries using oligo probes and antibodies		
2.4	Nucleic acid amplification and its application in medicine	• Develop new PCR amplification techniques & their role in disease identification	K6
2.5	DNA sequencing		K4
2.6	Site directed mutagenesis and protein engineering.		K6
III	**GENETIC ENGINEERING IN ANIMALS**		

3.1	**Genetic engineering in animals:** Methods of transferring genes in to animal oocytes, eggs embryos and specific tissues (physical chemical and biological methods)	• Develop novel method of gene transfer techniques in to animals & cell lines	K6
3.2	Cell lines and their applications- transgenic animals (mice, cow, goat, pigs, sheep and insects)		K6
IV	**MEDICAL BIOTECHNOLOGY**		
4.1	**Medical biotechnology:** Animal biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins	• Improve the production of food supplements through animal biotechnology	K6
4.2	Gene therapy- cloning	• Develop new gene therapy strategies	K6
4.3	Human Genome Project: Objectives, strategies and progress	• Define the basics of human genome project & its application.	K1
V	**BIOTECHNOLOGICAL APPLICATIONS**		
5.1	Bioremediation Types: In situ – Ex situ – Strategy	• Develop strategies for production & application of novel bioremediation methods	K6
5.2	Bioremediation: Biosensors, bioleaching, biochips and biofuels.		K6
5.3	Applications of Probiotics		K6
5.4	Applications: Healthcare; Agriculture & Industry		K6
5.5	DNA finger printing	• Improve the quality of DNA finger printing	K6
5.6	Environmental applications of biotechnology	• Propose new policies to protect & restore the quality of environment	K6
5.7	Biosafety and Bioethics	• Define legal & socio, economic issues related to biotechnology and their	K2

		ethical issues	

4. Mapping Scheme for the PO, PSOs and Cos

P19ZY3 :1	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M		L		L					M		L	
CO2		H						H					M
CO3	L			H		M			L		L		
CO4		L			L		H		M				M
CO5	L					H				L			
CO6			M					M			M	L	

L - Low **M - Medium** **H - High**

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation.** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.BENJAMIN

CORE-X: EVOLUTION AND ANIMAL BEHAVIOUR

SEMESTER- IV **COURSE CODE: P19ZY410**

CREDITS: 4 **HOURS /WEEK: 5**

1. COURSE OUTCOMES

After completing this course, the students will be able to:

NO	COURSE OUTCOMES	LEVEL	UNIT
CO1	Explain the origin of life on earth and theories with evidences	K5	I
CO2	Define the various factors which affected the evolution of sex and reproductive strategies	K3	II
CO3	Illustrate the concept of speciation and evolutionary time scale	K3	III
CO4	Explain the evolutionary history of man	K5	IV
CO5	Relate the different aspects of environmental perception and communication in animals.	K3	IV
CO6	Explain the various aspects of behavior and social organization in animals	K5	V

2. A. SYLLABUS

Evolution

Unit – I : EVOLUTION OVERVIEW (15 Hrs)

Origin of life – Abiogenesis —Lamarckism – Mutation theory of De Vries –Darwinism : Theory of Natural selection – Facts that influence Darwins thoughts - Current challenges to Darwinism: DNA and protein phylogenies – protein evolution and neutrality theory – Molecular evolutionary clock, Micro and macroevolution.

Unit – II : ISOLATION, SPECIATION AND FOSSILS (15 Hrs)

Isolation and Speciation: Isolating mechanism – Pre and post zygotic – origin of isolation – Koopman's experiment - Speciation – definition – modes – Sympatric –allopatric and quantum speciation.The evolutionary time scale- Fossil history and phylogeny of man – Cultural evolution and evolutionary future of mankind – Concepts of Exobiology.

Animal Behaviour

Unit – III : ETHOLOGY (15 Hrs)

Introduction to Ethology - Animal psychology, classification of behavioural patterns, analysisofbehaviour (ethogram) - Reflexes and complex behavior - Perception of the environment: mechanical, electrical, chemical,olfactory, auditory and visual - Neural and hormonal control of behavior - Genetic and environmental components in the development of behavior - Communication: Chemical, visual, light and audio, evolution oflanguage (primates).

Unit – IV : ANIMAL BEHAVIOUR AND BIOLOGICAL RHYTHMS (15 Hrs)

Ecological aspects of behaviour: Habitat selection, food selection,optimal foraging theory, anti -predator defenses, aggression, homing, territoriality, dispersal, host parasite relations.Biological rhythms: Circadian and circannual rhythms, orientationandnavigatio n, migration of fishes and birds. Learning and memory: Conditioning, habituation, insight le arning,association learning and reasoning.

Unit – V : REPRODUCTIVE BEHAVIOUR AND PARENTAL CARE (15 Hrs)

Reproductive behavior: Mating systems, courtship, sexualselection, parental care. Social Organisation in Honey bees and Primates - aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism,reciprocal altruism, inclusive fitness, social organization in insects and primates.

B. Topics for self study:

S.No	Topics	web links
1.	Phylogenetic trees	**https://courses.lumenlearning.com/suny-wmopen-biology1/chapter/phylogenetic-trees/**
2.	Molecular divergence	**https://www.ncbi.nlm.nih.gov/books/?term=Molecular+divergence**
3.	Molecular clocks	**http://www.as.wvu.edu/~kgarbutt/QuantGen/Gen535Papers2/Molecular_Clocks.htm**
4.	Chronopharmacology	**https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3885389/** **https://link.springer.com/chapter/10.1007/978-981-32-9779-1_16**
5.	Animal Domestication	**https://www.nationalgeographic.com/animals/reference/domesticated-animals/** **https://www.intechopen.com/books/animal-domestication/animal-domestication-a-brief-overview**

C. Text Books

1. Brian, K. H. and BenediktHall,G.Strickberger's Evolution. 4th Ed., 2008 Jones and Bartlett Publishers, Inc,
2. Goodenough, J., Betty, M. and Wallace, R.A. Perspectives on Animal Behaviour.1993 John Wiley,

D. Reference Books:

1. Futuyma, D.J.Evolutionary Biology. 3rd Ed.,1998 Sinauer Associates, Sunderland, Massachusetts,

2. Alcock, J. Animal Behaviour: An Evolutionary Approach. 7th Ed.,2001 Sinaur Associates, Inc.
3. Krebs, J.R and Davis, N.B. Behavioural Ecology. 3rd Ed., 1993 Blackwell,
4. Ridley, M. Evolution. 2nd Ed.,2004 Indian Edition. Blackwell Scientific Publishers, Oxford, UK,
5. Rastogi, V.B. Organic Evolution. 12th Ed., KedarNath Ram Nath, Meerut.

C. Text Books

1.Brian, K. H. and BenediktHall,G.Strickberger's Evolution. 4th Ed., 2008 Jones and Bartlett Publishers, Inc,
2.Goodenough, J., Betty, M. and Wallace, R.A. Perspectives on Animal Behaviour.1993 John Wiley,

D. Reference Books:

1. Futuyma, D.J.Evolutionary Biology. 3rd Ed.,1998 Sinauer Associates, Sunderland, Massachusetts,
2. Alcock, J. Animal Behaviour: An Evolutionary Approach. 7th Ed.,2001 Sinaur Associates, Inc.
3. Krebs, J.R and Davis, N.B. Behavioural Ecology. 3rd Ed., 1993 Blackwell,
4. Ridley, M. Evolution. 2nd Ed.,2004 Indian Edition. Blackwell Scientific Publishers, Oxford, UK,

Rastogi, V.B. Organic Evolution. 12th Ed., KedarNath Ram Nath, Meerut.

E. Web Links:

https://b-ok.asia/book/2325474/f08119
https://b-ok.asia/book/3504212/b99824
https://b-ok.asia/book/1250880/8dcac2

3. SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Course Contents	Specific Learning Outcomes (SLO)	Blooms Taxonomy levels of Transaction
I	**DARWINISM AND LAMARKISM**		
1.1	Origin of life – Abiogenesis – Cosmozoic and naturalistic theories – chemical evolution and origin of life – evidences and objections	• Explain how life might have originated on this planet	K2
1.2	Lamarckism – Mutation theory of De Vries –Darwinism : Theory of Natural selection – Facts that influence Darwins thoughts - Current challenges to Darwinism: DNA and	• Compare Lamarckism and mutation theory for evolution • Explain Darwin's theories on natural selection and	K2

	protein phylogenies – protein evolution and neutrality theory	challenges	
1.3	Molecular evolutionary clock, Micro and macroevolution. Evolution of sex and reproductive strategies.	• Compare micro and macro evolution	K2
II	**ISOLATION, SPECIATION AND PALAENTOLOGY**		
2.1	Isolation and Speciation: Isolating mechanism – Pre and post zygotic – origin of isolation –Koopman's experiment - Speciation – definition – modes – Sympatric –allopatric and quantum speciation.	• Explain the concept of speciation and gene regulation. • List out the examples and adaptation of both allopatric and sympatric speciation	K4
2.2	The evolutionary time scale: eras-periods and epoch-major events in the evolutionary time scale.	• Relate broad patterns in the fossil record to major geological events in time scale	K1
2.3	Fossil history and phylogeny of man – Cultural evolution and evolutionary future of mankind. Concepts of Exobiology.	• • Explain hominid evolution by discussing landmark phylogenetic transition and also cultural evolution in relation to society.	K5
III	**ETHOLOGY**		
3.1	Introduction to Ethology - Animal psychology, classification of behavioural patterns, analysis of behaviour (ethogram) - Reflexes and complex behavior -	• Classify behavioral patterns and reflexes	K4
3.2	Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual - Neural and hormonal control of behavior - Genetic and environmental components in the development of behavior -	• • Analyse the significance of animal perception and develop methods to regulate animal behavior	K6

3.3	Communication: Chemical, visual, light and audio, evolution of language (primates).	• Illustrate the forms of communication in animals and its role in language development.	K3
IV	**ANIMAL BEHAVIOUR AND BIOLOGICAL RHYTHMS**		
4.1	Ecological aspects of behaviour: Habitat selection, food selection,optimal foraging theory, anti -predator defenses, aggression, homing, territoriality, dispersal, host parasite relations	• Define habitat selection, foraging pattern and defense mechansims	K2
4.2	Circadian and circannual rhythms, orientation and navigation, migration of fishes and birds.	• Explain the regulation of circadian rhythms	K4
4.3	Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.	• Explain the role of biology in learning and memory and its form.	K5
V	**REPRODUCTIVE BEHAVIOUR AND PARENTAL CARE**		
5	Reproductive behavior: Mating systems, courtship, sexual selection, parental care.	• Analyse the importance of reproductive behavior and parental care in species perpetuation.	K4
	Social Organisation in Honey bees and Primates - aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.	• Analyze the social • organization in survival of animals	K4

4. Mapping Scheme for the PO, PSOs and COs

P19ZY410	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	H	M	H	L	M	H	H	M	H	H	H	L
CO2	H	H	M	M	L	L	H	M	L	H	H	H	L
CO3	H	H	L	L	L	L	H	M	L	H	H	H	L
CO4	H	H	L	L	L	M	H	H	L	H	H	H	L
CO5	H	H	L	L	L	L	H	M	M	H	H	H	L

CO6	H	H	L	M	L	L	H	L	M	H	H	H	L

L-Low **M-Moderate** **H- High**

5. COURSE ASSESSMENT METHODS

1. **Continuous Assessment Test I,II**
2. **Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation.**
3. **End Semester Examination**

COURSE CO-ORDINATOR: Dr.KAMALA KANNAN

ELECTIVE - V: APPLIED ENTOMOLOGY/BIOINFORMATICS

SEMESTER: IV **COURSE CODE: P19ZY4:5/P19ZY4:A**

CREDIT: 4 **HOURS /WEEK: 5**

1. Course Outcome

On completion of this course, the students will be able to :

CO.No.	COURSE OUTCOMES	LEVEL	UNIT
CO1	Classify the different orders of insect organisms	K4	I
CO2	Categorize the biological life cycle of agricultural and industrial important pests.	K4	II
CO3	Examine the structure and mode of action of important insecticides belonging to different groups	K4	III
CO4	Apply Integrated Pest Management	K4	IV
CO5	Recommend methods of insect control and the damages and benefits regarding practical applications.	K5	V
CO6	Improve employability skills of students to become an entomologist in government and private sectors.	K6	V

2. A. SYLLABUS

Unit: I INSECT CLASSIFICATION **15hrs**

Introduction to Entomology - General characters of Class Insecta –Outline Classification of insects upto orders Classification of following insect orders Orthoptera, Hemiptera, Diptera, Hymenoptera, Lepidoptera, Coleoptera, Insect Pest and their Classification

Unit: II PEST OF AGRICULTURAL AND INDUSTRIAL IMPORTANCE 15hrs

Life history, nature of damage and control measures of major pests of Pest of rice: Rice stem borer (Scirpophaga incertulas) - Pest of Sugarcane: The shoot borer (Chiloinfuscatellus) - Pest of coconut: The rhinoceros beetle (Oryctes rhinoceros) - Pest of cotton: The spotted bollworm (Earias insulana)- Pests of Stored Products. **Insects of Industrial importance** - Biology and rearing of Honey bees, Silk worm, Lac insect–Useful Products and their Economic Values.

Unit-III: PEST OF MEDICAL AND VETERINARY IMPORTANCE 15hrs

Insect vectors of human diseases; Mosquitoes, Bedbug, TseTse fly - Identification, nature of attack, and control measures. Veterinary pests: Identification, nature of attack, and control measures of insect pest of domestic animals – Fowl, cattle, sheep and goat. Insects of forensic importance – crime detection using entomological science.

Unit : IV PEST CONTROL MEASURES 15hrs

Pest control measures: Cultural–mechanical–physical and Biological methods - **Chemical control-** Insecticides - classification of insecticides based on mode of entry – mode of action and chemical nature –Insecticidal formulations– insecticidal toxicity (LD 50 / LC 50).

Unit: V IPM - BIOLOGICAL CONTROL 15hrs

Insect pest-Management: Biological control; Ecological basis and agents of biological control–Parasites, Parasitoids, Predators. Autocidal control. Methods of sterilisation – Male Sterilization technique, Chemo sterilants. Pheromonal control, Insect repellents, Insect anti feedants, Insect attractants – definition, applications, advantages and disadvantages. Microbial control of crop pests by employing bacteria, virus and fungi - Integrated pest management (IPM).

B. Topics for Self-Study :

S.No.	Contents	Web Link
1.	Tritrophic Interactions	https://en.wikipedia.org/wiki/Tritrophic_interactions_in_plant_defense
2.	Sterile insect release method	https://ipmworld.umn.edu/bartlett
3.	Biology and Control of Pulse Crop Pests	https://www.ag.ndsu.edu/publications/crops/pulse-crop-insect-diagnostic-series-field-pea-lentil-and-chickpea
4.	*Corcyra cephalonica*	https://www.plantwise.org/KnowledgeBank/datasheet/15444
5.	Forensic Entomology	https://ifflab.org/forensic-entomology-using-insects-for-forensic-investigations/

C. Text Books:

1. David, B.V. and Ananthakrishnan, T.N., General and Applied Entomology. 2nd Ed., 2004, Tata McGraw Hill, New Delhi.

2. Ignacimuthu, S. S and Jayaraj S, Biological Control of Insect Pests2003 Phoenix Publ, New Delhi.

D. Reference Books:

1. David, B.V. Elements of Economic Zoology. 2003, Popular Book Depot, Chennai.

2. Nalinasundari, M.S. and Santhi, R. Entomology. 2006, MJP Publishers, Chennai.

3. Awasthi, V.B. Introduction to General and Applied Entomology. 2002, Scientific Publishers, Jodhpur.

4. Norris, R.F., Caswell-chen, E.P. and Kogan, M. Concepts in Integrated Pest management 2002, Prentice Hall, New Delhi.

5. Racheigl and Racheigl, Biological and Biotechnological Control of Insect Pests.1998, CRC Press.

6. Srivastava, K. P., A, Textbook of Applied Entomology Vol. I. 2nd ed. 1988 Kalyani Publishers, New Delhi.

E. Web Links:

https://nptel.ac.in/courses/126/104/126104003/

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/Section	Contents	Specific Learning Outcomes (SLO)	Highest Blooms Taxonomical level of Transaction
I	**INSECT CLASSIFICATION**		
1.1	Insect Classification: - Introduction to Entomology – General characters of Class Insecta – Outline Classification of insects up to orders Classification of following insect orders Orthoptera, Hemiptera, Diptera, Hymenoptera, Lepidoptera, Coleoptera, Insect Pest and their Classification.	• Classify insects according to their orders	K4
II	• **PEST OF AGRICULTURAL AND INDUSTRIAL IMPORTANCE**		
2.1	Pest of Agricultural and industrial importance: - Life history, nature of damage and control measures of major pests of Pest of rice: Rice stem borer (Scirpophaga incertulas) – Pest of Sugarcane: The shoot borer (Chiloinfuscatellus) – Pest of coconut: The rhinoceros beetle (Oryctes rhinoceros) – Pest of	• Apply various control measures to eliminate the damage causing pests.	K3

	cotton: The spotted bollworm (Earias insulana) – Pests of Stored Products.		
2.2	Insects of Industrial importance – Biology and rearing of Honey bees, Silk worm, Lac insect – Useful Products and their Economic Values.	• Categorize the importance of insects in industrial purpose	K4
III	• **PEST OF MEDICAL AND VETERINARY IMPORTANCE**		
3.1	Pest of medical and veterinary importance: - Insect vectors of human diseases; Mosquitoes, Housefly, Bedbug, Sand fly, TseTse fly – Identification, nature of attack, and control measures.	• Analyze the nature of human diseases caused by insect vectors.	K4
3.2	Veterinary pests: Identification, nature of attack, and control measures of insect pest of domestic animals – Fowl, cattle, sheep and goat.	• Classify the nature of diseases caused by insect vectors in domestic animals and apply various control measures to eliminate veterinary pests.	K4
3.3	Insects of forensic importance – crime detection using entomological science.	• Identify insects in criminal investigation	K4
IV	• **PEST CONTROL MEASURES**		
4.1	Pest control measures: - Cultural–mechanical – physical and Biological methods – Chemical control – Insecticides	• Apply various pest control measures	K4
4.2	classification of insecticides	• Classify	K4

	based on mode of entry – mode of action and chemical nature – Insecticidal formulations – insecticidal toxicity (LD50/LC 50).	insecticides based on mode of entry, action and chemical nature	
V	• **IPM - BIOLOGICAL CONTROL**		
5.1	Insect pest – Management: Biological control; Ecological basis and agents of biological control–Parasites, Parasitoids, Predators. Autocidal control.	• Evaluate insect pest management using biological approach	K5
5.2	Methods of sterilisation – Male Sterilization technique, Chemo sterilant. Pheromonal control, Insect repellents, Insect antifeedants, Insect attractants – definition, applications, advantages and disadvantages.	• Utilize available sterilisation methods to control insect pests	K3
5.3	Microbial control of crop pests by employing bacteria, virus and fungi – Integrated pest management (IPM).	• Improve integrated pest management system for microbial pest control.	K6

4. Mapping Scheme for the PO, PSOs and Cos

P19ZY4:1	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	L			L			M			M		L	
CO2	M		L			L			M		M		
CO3		M			L			M					H
CO4				M	M	H					M		
CO5			M						M			L	
CO6	M			M			H			L			M

L - Low **M - Medium** **H - High**

5. COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I,II **2. Cooperative learning report, Assignment; Journal paper review, Group Presentation, Poster preparation,** **3. End Semester Examination**
Indirect
1. Course-end survey

COURSE CO-ORDINATOR: Dr.J.NESARAJAN

PG - PROGRAMME ARTICULATION MATRIX

S.No	COURSE NAME	COURSE CODE	Correlation with Programme Outcomes and Programme								
			PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PS 1
1	Functional Morphology of Invertebrates and Chordates	P19ZY101	H	H	H	L	L	-	H	H	-	H
2	Cell Biology	P19ZY102	H	-	M	H	H	H	H	L	-	-
3	Molecular Biology and Bioinformatics	P19ZY103	H	-	M	H	H	H	H	-	-	-
4	Core Practical I	P19ZY1P1	H	-	H	H	H	H	H	H	-	-
5	Core Practical II	P19ZY1P2	H	-	H	H	H	H	H	H	-	-
6	Microbiology	P19ZY1:1	H	-	H	H	H	H	H	L	-	-
7	Animal Physiology	P19ZY204	H	-	H	H	H	H	H	H	-	H
8	Biochemistry	P19ZY205	H	-	M	H	H	H	H	-	-	-
9	Immunology	P19ZY2:1	H	-	H	H	H	H	H	M	-	-
10	Biostatistics	P19ZY2:3	H	-	H	H	H	H	H	-	-	-
11	Core Practical III	P19ZY2P3	H	-	H	H	H	H	H	-	-	M
12	Core Practical IV	P19ZY2P4	H	-	-	H	H	H	H	-	-	-
13	Environmental Biology	P19ZY306	H	H	H	H	H	H	H	H	H	-
14	Developmental Biology	P19ZY307	H	-	-	H	H	H	H	M	-	M
15	Genetics	P19ZY308	H	-	-	H	H	H	H	-	-	M
16	Research Methodology and Biotechniques	P19ZY309	H	-	-	H	H	H	H	-	-	L
17	Core Practical V	P19ZY3P5	H	H	H	H	H	H	H	-	H	-
18	Animal Biotechnology	P19ZY3:1	H	-	-	H	H	H	H	H	-	L
19	Evolution and Animal Behaviour	P15ZY410	H	H	H	H	H	H	H	H	-	
20	Applied Entomology	P15ZY4:1	H	-	M	H	H	H	H	M	H	

PROJECT

Semester-IV **Code: P19ZY4PJ**

Credits : 5 **Total Hrs. : 300**