`

ETHIRAJ COLLEGE FOR WOMEN, (AUTONOMOUS) CHENNAI-600008

PG & RESEARCH DEPARTMENT OF ZOOLOGY

PG SYLLABUS

CHOICE BASED CREDIT SYSTEM

OUTCOME BASED EDUCATION

(OFFERED FROM THE ACADEMIC YEAR 2021-22)

CONTENTS

RULES AND REGULATIONS FOR THE PROGRAMME

1. ELIGIBILITY FOR ADMISSION

Preamble

A candidate who has passed the B.Sc., Degree Examination in branch VI and VI a Zoology Main of Madras University or an examination of some other University accepted by the syndicate as equivalent they shall be admitted and permitted to appear and qualify for the M.Sc., Degree examination of the University after a course of two academic year (4 semester).

2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than two academic years and passed the examinations of all the four semesters prescribed.

3. EXAMINATION

There shall be four examinations; one at the end of each semester. A candidate who does not pass the examination in any subject of the first semester will be permitted to appear in such failed subject or subjects along with the second, third and fourth semester examinations.

4. COURSE OF STUDY - CBCS FOR PG

S.N0	SUBJECT	NO OF COURSES	CREDIT PER COURSE	TOTAL CREDITS
1.	CORE SUBJECT (INCLUDING PRACTICALS)	15	4	60
2.	ELECTIVES (MAJOR) PROJECT	4 1	3 3	12 3
3.	ELECTIVES (NON MAJOR)	2	3	6
4.	SOFT SKILL	4	2	8
5.	INTERNSHIP	1	2	2
			TOTAL	91

5. RANKING CRITERIA

S.N0	CRITERIA	RANKING
1.	Pass Mark	50%
2.	II Class	50% - 60%
3.	I Class	60% and above

6. QUESTION PAPER PATTERN

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
Part A	Descriptions	5 x 8= 40
Part B	Application/ Analysis / Synthesis / Evaluation	3 x 20 = 60

Part A: 5 questions have to be answered out of 8 covering all 5 units.

Part B: 3 questions have to be answered out of 5 questions covering all the five units.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

On obtaining a Postgraduate degree the students will be able to:

PEO1 Display higher order thinking in the knowledge domain and demonstrate professional skills

PEO2 Contribute to the advancement and application of relevant knowledge by self-directed learning

PEO3 Extend and integrate knowledge and skills to design and develop novel products and explore innovative solutions to national and international goals of development.

PEO4 Exercise management skills and develop social interactions in a responsive, ethical and constructive way to meet global standards of excellence in all spheres of activity.

PEO5 Strive for social and economic equity based on the need for gender parity and ecological sustainability.

PROGRAMME OUTCOMES (PO)

PO1 – To acquire advanced conceptual knowledge and comprehensive understanding of the fundamental principles in respective discipline.

PO2 – To apply knowledge and critically evaluate the concepts and scientific developments to take up any challenge.

PO3 - To visualize and work on laboratory multidisciplinary tasks related to current research in the fields of Mathematical, Physical and Life sciences

PO4 – To acquire research based knowledge and design methods to conduct investigations of complex problems in research/ Industrial field and achieve employability / self employment.

PO5- To communicate effectively ideas verbally in English, leading to Entrepreneurship ventures such as consultancy and training.

PO6- Employ innovative and environment friendly methods, novel ideas to solve complex and challenging societal and environmental issues.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1 - To enhance the knowledge in advanced areas of zoology.

PSO2 - A deeper understanding of key concepts in biology at cellular, biochemical, physiological, embryological,ecological and molecular level.

PSO3 - Students gain knowledge and skills in the fundamentals of behavioral sciences, animal association and their relation to the environment.

PSO4 -To promote learning and create interest in research.

PSO5 - To develop scientific approach and problem solving skills.

PSO6 -Update the modern trends in biological research and help to seek job opportunities worldwide.

SEM	PART	COURSE CODE	TITLE OF THE PAPER	HOURS / WEEK	CREDITS	TOTAL HOURS	CA	SE	TOTAL
I	III	5P21/1C/FMI	PAPER-I-Functional Morphology and Systematics of Invertebrates	5	4	75	40	60	100
I	III	5P21/1C/GEN	PAPER-II Genetics	5	4	75	40	60	100
I	III	5P21/1C/MBY	PAPER-III-Molecular Biology	6	4	90	40	60	100
I	III	5P21/1E1/MIC	ELECTIVE-I-Microbiology	4	3	60	40	60	100
I	III		SOFT SKILL-Personality Enrichment for Women	2	2	30			50
II	III	5P21/2C/FMC	PAPER-IV-Functional Morphology and Systematics of Chordates	4	4	60	40	60	100
II	III	5P21/2C/BBB	PAPER-V-Biophysics, Biostatistics and Bioinformatics	5	4	75	40	60	100
II	III	5P21/2E2/EAB	ELECTIVE-II Evolution and Animal Behaviour	4	3	60	40	60	100
II	III	5P21/2E3/MEY	ELECTIVE-III-Mammalian Endocrinology	4	3	60	40	60	100

I & II	III	5P21/2C/MP1	PRACTICAL I-Invertebrata, Chordata and Microbiology	4	4	60	40	60	100
I & II	III	5P21/2C/MP2	PRACTICAL II-Molecular Biology, Genetics, Biophysics and Biostatistics	4	4	60	40	60	100
II	III	5P21/2D/INS	INTERNSHIP	--	2	-	-	-	100
II	III		SOFT SKILL-II-Other languages	2	2	30			50
III	III	5P21/3C/APY	PAPER-VI-Animal Physiology	4	4	60	40	60	100
III	III	5P21/3C/EBC	PAPER-VII-Environmental Biology and Biodiversity conservation	4	4	60	40	60	100
III	III	5P21/3C/IMM	PAPER-VIII-Immunology	4	4	60	40	60	100
III	III	5P21/3E4/RDT	ELECTIVE-IV-rDNA Technology	4	3	60	40	60	100
III	III	5P21/3S/DFG	Soft skill - III Dairy Farming	2	2	30			50
IV	III	5P21/4C/DBY	PAPER-IX-Developmental Biology	5	4	75	40	60	100
IV	III	5P21/4C/BIO	PAPER-X-Biochemistry	5	4	75	40	60	100
IV	III	5P21/4C/AQU	PAPER-XI-Aquaculture	5	4	75	40	60	100
IV	III	5P21/4C/PRO	PROJECT	5	3	75	40	60	100

IV	III	5P21/4S/PFM	Soft Skill- IV Poultry Farming	2	2	30			50
III & IV	III	5P21/4C/MP3	PRACTICAL III- Animal Physiology, Biochemistry, Immunology and Recombinant DNA Technology	4	4	60	40	60	100
III & IV	III	5P21/4C/MP4	PRACTICAL IV- Developmental Biology, Environmental Biology and Aquaculture	4	4	60	40	60	100

NON-MAJOR ELECTIVE

SEM	PART	COURSE CODE	TITLE OF THE PAPER	HOURS/ WEEK	CREDITS	TOTAL HOURS	CA	SE	TOTAL
II		5P21/2E/MCC	Maternity and Child Care	4	3	60	40	60	100
III		5P21/3E/AQF	Aquarium Fishes	4	3	60	40	60	100

1	EXTRA CREDITS (OPTIONAL)	Self Study Paper Semester III	Research Methodology	-	2	-	-	100	100

EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT

INTERNAL VALUATION BY COURSE TEACHERS

CORE/ELECTIVE-THEORY PAPERS

COMPONENT	TIME	MAX.MARKS	CA MARK
TEST I	2 HRS	50 MARKS (TO BE CONVERTED)	10
TEST II	2 HRS	50 MARKS (TO BE CONVERTED)	10
ASSIGNMENT / SEMINAR/FIELD VISIT			10
PARTICIPATORY LEARNING			10
TOTAL			**40**

CORE / ELECTIVE-PRACTICAL PAPERS

COMPONENT	CA MARKS
Test I	10
Test II	10
Observation	10
Model exam	50 (To be converted to 10)
Total	**40**

INTERNSHIP AND PROJECT
CA COMPONENT - NIL

SOFT SKILL PAPERS

CA COMPONENT - NIL

RUBRIC FOR CONTINUOUS ASSESSMENT

Assignment	Content/Originality/Presentation/Schematic Representation and Diagram/Bibliography
Seminar	Organization/Subject Knowledge/Visual Aids/Confidence level/presentation-Communication and Language
Field Visit	Participation/Preparation/Attitude/Leadership
Participation	Answering Questions/Clearing Doubts/Participating in Group Discussions/Regular Attendance
Case Study	Finding the Problem/Analysis/Solution/Justification
Problem Solving	Understanding Concepts/Formula and Variable Identification/Logical Sequence/Answer
Group Discussion	Preparation/Situation Analysis/Relationship Management/Information Exchange/Delivery Skills
Flipped/Blended Learning	Preparation/Information Exchange/ Group interaction/Clearing doubts

- FIRST FOUR RUBRIC SHOULD BE INCLUDED.
- OTHERS ARE OPTIONAL BASED ON TEACHING-LEARNING METHODOLOGY ADOPTED FOR THE PROGRAMME OF STUDY

END SEMESTER EVALUATION PATTERN-PG

THEORY PAPERS

SEMESTERI/II/III/IV

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNALEXAMINER
MAXIMUM MARKS: 100 TO BE CONVERTED TO 60
PASSING MARK: 50

PRACTICAL PAPERS

SEMESTER I/II/III/IV

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER
MAXIMUM MARKS: 100 TO BE CONVERTED TO 60
PASSING MARK: 50

SOFT SKILL PAPERS

SEMESTER I/II/III/IV
SINGLE VALUATION BY COURSE TEACHER
MAXIMUM MARK:50
PASSING MARK: 25

INTERNSHIP

I YEAR IISEMESTER

PROJECT

II YEAR IV SEMESTER

DOUBLE VALUATION BY RESEARCH SUPERVISOR AND EXTERNAL EXAMINER
DISSERTATION: 60
VIVAVOCE :40
MAXIMUM MARK:100
PASSING MARK:50

COURSE PROFILE-PROGRAMME OF STUDY

SEM	COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS /WK	TOTAL HOURS	L-T-P	CA	SE	TOTAL
I	5P21/1C/FMI	PAPER-I-Functional Morphology and Systematics of Invertebrates	4	5	75	3-2-0	40	60	100
	5P21/1C/GEN	PAPER-II Genetics	4	5	75	3-2-0	40	60	100
	5P21/1C/MBY	PAPER-III-Molecular Biology	4	6	90	4-2-0	40	60	100
	5P21/1E1/MIC	ELECTIVE-I-Microbiology	3	4	60	2-2-0	40	60	100
		SOFT SKILL-Personality Enrichment for Women	2	2	30	2-0-0	-	-	50
II	5P21/2C/FMC	PAPER-IV-Functional Morphology and Systematics of Chordates	4	4	60	3-2-0	40	60	100
	5P21/2C/BBB	PAPER-V-Biophysics, Biostatistics and Bioinformatics	4	5	75	3-2-0	40	60	100
	5P21/2E2/EAB	ELECTIVE-II Evolution and Animal Behaviour	3	4	60	2-2-0	40	60	100

	5P21/2E3/MEY	ELECTIVE-III-Mammalian Endocrinology	3	4	60	2-2-0	40	60	100
	5P21/2C/MP1	PRACTICAL I-Invertebrata, Chordata and Microbiology	4	4	60	0-0-8	40	60	100
	5P21/2C/MP2	PRACTICAL II-Molecular Biology, Genetics, Biophysics and Biostatistics	4	4	60	0-0-8	40	60	100
	5P21/2D/INS	INTERNSHIP	2	--	-	-	-	-	100
		SOFT SKILL-II-Other languages	2	2	30	2-0-0			50
III	5P21/3C/APY	PAPER-VI-Animal Physiology	4	4	60	3-1-0	40	60	100
	5P21/3C/EBC	PAPER-VII-Environmental Biology and Biodiversity conservation	4	4	60	3-1-0	40	60	100
	5P21/3C/IMM	PAPER-VIII-Immunology	4	4	60	3-1-0	40	60	100
	5P21/3E4/RDT	ELECTIVE-IV-rDNA Technology	3	4	60	3-1-0	40	60	100
	5P21/3S/DFG	Soft skill - III Dairy Farming	2	2	30	2-0-0			50
IV	5P21/4C/DBY	PAPER-IX-Developmental Biology	4	5	75	3-2-0	40	60	100
	5P21/4C/BIO	PAPER-X-Biochemistry	4	5	75	3-2-0	40	60	100
	5P21/4C/AQU	PAPER-XI-Aquaculture	4	5	75	3-2-0	40	60	100

	5P21/4C/PRO	PROJECT	3	5	75	3-2-0	40	60	100
	5P21/4S/PFM	Soft Skill- IV Poultry Farming	2	2	30	2-0-0			50
	5P21/4C/MP3	PRACTICAL III- Animal Physiology, Biochemistry, Immunology and Recombinant DNA Technology	4	4	60	0-0-8	40	60	100
	5P21/4C/MP4	PRACTICAL IV- Developmental Biology, Environmental Biology and Aquaculture	4	4	60	0-0-8	40	60	100
		TOTAL CREDITS	85						

NON-MAJOR ELECTIVE (Offered to other Department Students)

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WK	TOTAL HOURS	L-T-P	CA	SE	TOTAL
5P21/2E/MCC	Maternity and Child Care	3	4	60	2-2-0	40	60	100
5P21/3E/AQF	Aquarium Fishes	3	4	60	2-2-0	40	60	100
	TOTAL CREDITS	6						

S.No.			TITLE OF THE PAPER	CREDITS	HOURS / WK	TOTAL HOURS	CA	SE	TOTAL
1	EXTRA CREDITS (OPTIONAL)	Self Study Paper Semester III	Research Methodology	2	-	-	-	100	100

SEMESTER I

PAPER-I-FUNCTIONAL MORPHOLOGY AND SYSTEMATICS OF INVERTEBRATES

TOTAL HOURS: 75 **COURSE CODE:5P21/1C/FMI**

CREDITS: 4 **L-T-P: 3-2-0**

COURSE OBJECTIVES:

1. To describe the origin of Protozoa and Hydrostatic movement.
2. To compare and understand Digestive, Respiratory Mechanism in Invertebrates.
3. To compare and understand Excretion and Nervous system in Invertebrates.
4. To expand the knowledge on Invertebrates larval forms.
5. Interpret the structure and affinities and life history of Minor Phyla.

COURSE OUTLINE:

UNIT I

Symmetry in animal organisation (Asymmetry,radial,biradial,bilateral)-Origin of metazoa - organization of coelom: acoelomates, pseudocoelomates, coelomates. Origin of Bilateria, Locomotion- amoeboid, flagellar and ciliary movements in Protozoans.Hydrostatic movements in Coelenterata, Annelida and Echinodermata.**(15Hrs)**

UNIT II

Filter feeding in Polychaetes - Patterns of feeding and nutrition in Mollusca, Echinodermata. Respiration- Organs of respiration: gills, lungs and trachaea. Respiratory pigments.Mechanism of respiration. **(15Hrs)**

UNIT III

Excretion:-Different types of excretory organs in invertebrates –their structure and function - -Mechanism of osmoregulation in invertebrates.

Nervous system:- 1.Primitive nervous system- Coelenterata and Echinodermata.

2. Advanced nervous system – Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda) **(15Hrs)**

UNIT IV

Invertebrate larval forms and their evolutionary significance - Trematoda, Cestoda, Crustacea, Mollusca, Echinodermata.Sedentary invertebrates, Regeneration in invertebrates, Endocrine glands and their function in crustaceans andinsects

(15Hrs)

UNIT V

Structures, affinities and life history of the following minor phyla- Rotifera, Entoprocta, Phoronida and Ectoprocta, Acanthocephala, Gastrotricha, Chaetognatha. Fossil records of important Trilobites,cephalopods (Ammonoides,NautiloidesBelemnoides) and Echinoderm fossils **(15Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Invertebrate structure and function	Barrington, E.J.W	Thomas Nelson and Sons Ltd., London	1962
2	Invertebrate Zoology	Robert D. Barnes	Cengage	2006

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	The invertebrates	Hyman, L.H.	McGraw Hill Co.,	1955
2.	Comparative Anatomy of the Vertebrates	Kent, G.C. And Carr R.K.	The McGraw-Hill Companies	2000
3.	Invertebrates	Richard C. Brusca, Gary J. Brusca	Sinauer Associates; 2nd Edition edition	2003
4.	Textbook of Invertebrate Zoology	Dev Bhattacharya	Arjun Publishing House; 1 edition	2018

5.	Invertebrate Zoology	John smith	Intelliz Press	2017

JOURNALS:

Journal of Invertebrate Pathology

International Journal of Science and Research (IJSR)

E-LEARNING RESOURCES:
https://archive.org/details/zoologyofinverte00ship
https://www.embibe.com/study/invertebrata
https://explorable.com/
https://www.encyclopedia.com/plants-and-animals/animals/zoology-invertebrates/invertebrates
http://www.biologydiscussion.com/invertebrate-zoology/phylum-rotifera/phylum-rotifera-taxonomic-history-characteristics-and-affinities/32922

COURSE OUTCOMES:

CO	CO STATEMENT
CO 1	**Students will be able to** To explain the origin of Protozoa and Hydrostatic movement.
CO 2	To discuss the Excretion and Nervous system in Invertebrates.
CO 3	To compare the Digestive, Respiratory Mechanism in Invertebrates.
CO 4	To explain the larval forms in Invertebrates
CO 5	To outline the structure and affinities of Minor Phyla.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	2	2
CO2	2	3	2	2	2	2
CO3	2	3	3	2	2	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2
AVERAGE	2	2.6	2.2	2	2	2

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER I

PAPER-II GENETICS

TOTAL HOURS: 75 **COURSE CODE:5P21/1C/GEN**

CREDITS : 4 **L-T-P : 3-2-0**

COURSE OBJECTIVES:

To enable the students

1. To explain the concept of molecular genetics.
2. To gain knowledge on chromosomal mapping and banding techniques.
3. To analyze strategies of somatic cell and microbial genetics.
4. To formulate the genetics of cell cycle.
5. To develop knowledge on DNA recombination and Repair.

COURSE OUTLINE:

UNIT I

Organisation of genes and chromosomes - chromatin – nucleosome – structure of eukaryotic chromosome – centromere – kinetochore – telomere – unique and repetitive chromosome - karyotyping and chromosome banding technique – Gene bank.

(15Hrs)

UNIT II

Chromosome mapping - Sex-determination and dosage compensation in *C.elegans*, Drosophila and human - transposable elements in prokaryote and eukaryotes - Genetic imprinting Epigenetic regulation by DNA methylation. **(15Hrs)**

UNIT III

Somatic cell genetics - Cell fusion and technology - Heterokaryon selecting hybrids and hybridoma - microbial genetics - Bacterial conjugation, transformation and transduction. **(15Hrs)**

UNIT IV

Genetics of cell cycle - Genetic regulation of cell division in yeast and eukaryotes - Regulation of CDK- cyclin activities - Molecular basis of cellular check points – Genetic components in common diseases. **(15Hrs)**

UNIT V

Recombination and repair - Recombination: homologous and non-homologous recombination - Site-specific and transpositional recombination - DNA repair mechanism in prokaryotes and eukaryotes. **(15Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Concepts of genetics	Klug, cummings& spencer	Pearson education India; tenth edition	2016
2.	Genetics: A Conceptual	Benjamin Pierce	WH Freeman; 6th edition	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Genes IX	Benjamin Lewin	Jones and Bartlett Publishers, Inc; 9th Revised edition edition	2007
2.	Genetics: A Molecular Approach	Russell	Pearson Education India	2010
3.	Genetics: Analysis of Genes and Genomes	Daniel L. Hartl,andMaryellenRuvolo	Laxmi Publications	2011
4.	Principles of Genetics	Gardner, Simmons and Snustad	Wiley; 8 Edition	2006
5.	Molecular Biology of the Gene	James D. Watson A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard.	Pearson Education; Seventh edition	2017

JOURNALS:

Journal of Genetics

Indian Journal of Human Genetics

E-LEARNING RESOURCES:

https://nptel.ac.in/courses/102103012/pdf/mod2.pdf

www.lamission.edu/lifesciences/steven/micro20%20chapter%208.pdf

https://www.karger.com/Article/PDF/154949

https://www.cliffsnotes.com/study-guides/biology/biochemistry-ii/dna-structure-replication-and-repair/dna-recombination-and-repair

COURSE OUTCOMES:
On successful completion of the course the students will be able to

CO NUMBER	CO STATEMENT
CO1	Explain the gene and chromosomal organisation in eukaryotic cell.
CO2	Apply advanced career-oriented technology such as chromosome banding and Karyotyping.
CO3	Relate the application of somatic cell and microbial genetics**.**
CO4	Examines the genetic basis and various checkpoints of cell cycle.
CO5	Evaluate the concepts of recombination and DNA repair mechanism in prokaryote and eukaryote system.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	2
CO2	3	3	3	3	3	3
CO3	3	3	3	3	2	3
CO4	3	3	2	3	2	3
CO5	3	3	3	2	2	2
AVERAGE	**3**	**2.8**	**2.6**	**2.6**	**2.2**	**2.6**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Smart Class, e-content, Group Discussion, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER I

PAPER III-MOLECULAR BIOLOGY

TOTAL HOURS: 90 **COURSE CODE: 5P21/IC/MBY**

CREDITS : 4 **L-T-P: 4-2-0**

COURSE OBJECTIVES:

1. To expertise at the molecular level on the organization and functioning of an eukaryotic genome and the mechanism of DNA damage and repair
2. To ascertain the students on the molecular mechanism of DNA replication of transcription in both prokaryotic and eukaryotic cells and its regulation.
3. To impart in-depth knowledge regarding the process of translation and posttranslational modifications in prokaryotic and eukaryotic cells and its regulation.
4. To describe the bases of on cogenesis and its treatment at the molecular level.
5. To compile the molecular mechanisms of signal transduction in a cell.

COURSE OUTLINE:

UNIT I

Genome organization – Gene structure, organelle genome, gene family, gene cluster, pseudo-genes. DNA damage and repair – types of DNA damages, excision repair system, mismatch repair, recombination repair, double strand break repair and transcription coupled repair. C value paradox – Cot ½ and Rot ½. **(18 Hrs)**

UNIT II

DNA replication – molecular mechanisms of prokaryotic and eukaryotic DNA, replication, regulation of replication. Transcription - prokaryotic and eukaryotic transcription, RNA polymerases, transcriptional unit, initiation, elongation, termination, transcriptional factors. Regulation of transcription – Operon, positive and negative control, attenuation phage strategies, anti-termination, response elements and inducible elements. **(18 Hrs)**

UNIT III

Translation - prokaryotic and eukaryotic translation, genetic code, altered code in elongation, termination factors, fidelity of translation, post translational modifications. Mobile DNA elements – transposable elements, IS elements, P elements, retroviruses, retrotransposons. Antisense and ribozyme technology – initiation of splicing, polyadenylation, molecular mechanisms of antisense molecules, miRNA, siRNA, gene silencing. **(18 Hrs)**

UNIT IV

Cancer – Mutational nature of cancer – Carcinogenesis – tumor viruses – tumor suppressor genes – hormones in relation to cancer – treatment of cancer at molecular level. Aging - cellular theories of aging – pacemaker theories of aging - senescence. Apoptosis in mammals and its significance.

(18 Hrs)

UNIT V

Cell Signalling: Signalling mechanism, Signalling molecules, Cell surface receptors – G protein coupled receptors, Tyrosine kinase – Linked receptors – signal transduction pathway using second messengers – cAMP,cGMP and Ca2+. **(18 Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	The Cell	Cooper Geoffrey M.	Sinauer Associates Inc.,U.S.	2017
	Molecular Biology of the Gene	James D. Watson, Tania A. Baker	Pearson; 7 edition	2013

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Essentials of Cell and Molecular Biology	De Robertis. E.D.P and E.M.F. De Robertis	Saunders College Publishing	1990
2.	Cell and Molecular Biology	Gerald Karp	Wiley	1996
3.	Molecular cell biology – IV	Lodish, Berk, Zipursky, Matsudaria and Baltimore	W.H. Freeman and Company	1965
4.	Molecular Cell Biology	Arnold Berk, Chris A. Kaiser	WH Freeman; 8 edition	2016
5.	Cell and Molecular Biology	RobertisE.d.p. De	Lippincott Williams And Wilkins	2014

JOURNALS:

Cancer Genetics

Journal of Molecular Biology and Biotechnology

E-LEARNING RESOURCES:

https://www.dnalc.org/resources/3d/12-transcription-basic.html

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

https://www.ncbi.nlm.nih.gov/books/NBK9894/

https://www.cellsignal.com/contents/science/cst-pathways/science-pathways

https://www.sciencedirect.com

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	Understanding the structure and functions of an eukaryotic genome at the molecular level and the importance of DNA repair mechanism in cellular functioning.
CO 2	Understanding the molecular mechanisms involved in DNA replication and transcription in prokaryotic and eukaryotic cells.
CO 3	Gains knowledge on the mechanism of translation in prokaryotic and eukaryotic cells and the post translational modifications and regulations in protein synthesis.
CO 4	Creates awareness on the cause of oncogenesis and thereby enable the students to implement the preventive measures in the society.
CO 5	Understands the importance of cell signalling mechanism in the functioning of the cell.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	3	3	2	3
CO2	2	2	3	2	3	3
CO3	3	2	3	2	2	2
CO4	3	3	3	2	1	3
CO5	2	1	1	2	2	3
AVERAGE	**2.4**	**2**	**2.6**	**2.2**	**2**	**2.8**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHINGMETHODOLOGY:

Lecture by chalk and talk, Flipped Learning, e-content, Group discussions, Seminars, Power point presentations and Assignments.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER I

ELECTIVE I – MICROBIOLOGY

TEACHING HOURS: 60 **COURSE CODE: 5P21/1E1/MIC**

CREDITS: 3 **LTP: 2-2-0**

COURSE OBJECTIVES:

1. To explain the contributions made to the science of microbiology, to outline classification and domain kingdom of various microorganisms.
2. To describe the structures found in a typical bacterial cell & its function.
3. To compile the Bacterial nutrition, growth and microbial culture &control.
4. To describe the microbial metabolism, microbial interactions and their ecological adaptations.
5. To describe the infections transmitted by water, milk, air, food & dairy products.

COURSE OUTLINE:

UNIT-I

Introduction to Microbiology – History of Microbiology, Classification of microorganisms - Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese.

An outline classification of bacteria according to Bergey's Manual of Systematic & determinative Bacteriology – Domain and Kingdom.Major groups of Microorganisms and their general characters.

(12 Hrs)

UNIT – II

Microbial Cell Structure and Function: The prokaryotic cell (Bacteria), size, shape and arrangement of bacterial cells; prokaryotic Cell wall, plasma membrane (cell membranes), cytoplasmic matrix, flagellum, Fimbriae(pili), Slime layer & Capsule, mesosome, ribosomes, the nucleoid, the bacterial endospore. storage granules, nucleoid, photosynthetic apparatus & gram staining.

Microbial Nutrition:Nutritional Categories of microorganisms (bacteria) based on carbon (Heterotrophs & Autotrophs); energy (Phototrophs &Chemotrophs) and electron sources, etc.,

(12 Hrs)

UNIT – III

Culture media: Culture Medium; Types of culture media; Culture Techniques; Culture of Bacteria; Methods of Culturing Bacteria; Cultural Characteristics of Bacteria; Maintenance of Bacterial Culture; isolation and cultivation of pure cultures.

Microbial Growth and Control: Methods of bacterial growth (Binary fission, budding, filamentation& sporulation. The growth of bacterial culture techniques: Batch, continuous and synchronous culture & fed back culture. growth kinetics, growth curve, microbial growth measurements – gravimetry, turbidometry and nephelometry. Factors affecting microbial growth, the use of physical and chemical methods in microbial control, antimicrobial chemotherapy. **(12 Hrs)**

UNIT – IV

Microbial metabolism – Principle of microbial metabolism - Types, Chemosynthesis, photosynthesis, carbon assimilation & regulation of metabolism.

Microbial interactions and Microbial Ecology – Symbiosis, commensalism – mutualism between microbes, microbes and plants and animals – cooperation, competition, predation, antagonism, parasitism – animal parasites.

(12 Hrs)

UNIT – V

Applied Microbiology – bacteriology of air, water, milk. Microbes associated with food production, Food Spoilage; Food Poisoning; Food Preservation & Food Infections. Microbiology of milk and dairy products – control of microorganisms – physical, chemical and antimicrobial agents – biological weapons and bioterrorism.

(12 Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	A Text Book of Microbiology	Dubey R C and Maheshwari D K	S Chand and Company Ltd., New Delhi	2006
2	A Text Book of Microbiology	Chakraborty P A	New Central Book agency (Pvt. Ltd.,) 2nd Edition.	2005

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Microbiology	Michael J. Pelczar Jr. E.C.S. Chan Noel R. Krieg	McGraw-Hill Inc.,US	2007
2	General Microbiology	Powar, C.B. and Daginawala, H.F.	Himalaya Publishing House,New Delhi	2001
3	Text book of Microbiology	Arora, D.R AND Arora. B	CBS Publishers, New Central Book Agency, New Delhi.	2008
4	Microbiology	P. D. Sharma	Rastogi Publications	2011
5	Text book of Microbiology	Ananthanarayana n&Paniker	University Press (India) private limited, 8th edition	2009

JOURNALS:

International Journal of Microbiology Research

Indian Journal of Microbiology Research

E-LEARNING RESOURCES:

http://www.biologydiscussion.com/microorganisms/classification-of-microorganism-microbiology/64847

https://microbenotes.com/bergeys-manual-of-systematic-bacteriology-and-determinative-bacteriology/

https://open.oregonstate.education/generalmicrobiology/chapter/microbial-growth/

https://nptel.ac.in/courses/102103015/pdf/mod6.pdf

https://www.onlinebiologynotes.com/microbial-interaction-and-types-mutualism-syntropism-proto-cooperation-commensalism-antagonism-parasitism-predation-competition/

COURSE OUTCOMES:

Student will be able to

CO NUMBER	CO STATEMENT
CO 1	Explain the discoveries & different types of microbial classification.
CO 2	Outline the Ultra structure of Bacterial cell and their functions.
CO 3	Distinguish the types of nutrition, growth and its environmental influences.
CO 4	Describe microbial metabolism & compile the various microbial interactions, associated with the Environment.
CO 5	Comprehend the types of microbes in air, water, milk & food, its methods to assess & detect.

MAPPING - COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	3	2
CO2	3	2	3	2	2	3
CO3	3	3	2	3	2	2
CO4	2	2	2	3	2	2
CO5	2	3	3	3	3	3
AVERAGE	**2.6**	**2.6**	**2.4**	**2.6**	**2.4**	**2.4**

KEY: **S**TRONGLY CORRELATED - 3 **M**ODERATELY CORRELATED - 2 **W**EAKLY CORRELATED - 1 **N**O CORRELATION - 0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Smart Class, e-content, Videos, Group Discussion, PPT, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4, K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER II
PAPER IV – FUNCTIONAL MORPHOLOGY AND SYSTEMATICS OF CHORDATES

TOTAL HOURS: 60 **COURSE CODE: 5P21/2C/FMC**
CREDITS : 4 **L-T-P: 3-1-0**
COURSE OBJECTIVES:

1. To describe the origin of Chordates.
2. To describe the origin of Reptiles, Aves and Mammals.
3. To study the Comparative Anatomy in Vertebrates.
4. To develop knowledge about Vertebrates integument and other systems.
5. To develop knowledge about Evolution of Horse and Man.

COURSE OUTLINE:

UNIT I

Origin and ancestry of Chordata, General organization and affinities of Cephalochordata. Origin of Fishes. General organisation and characters of Fishes.General characters and affinities of Dipnoi. Origin of Amphibia. General organisation and characters of Amphibians.Origin and evolution of paired fins and limbs

(12Hrs)

UNIT II

Origin of Reptiles,Birds and Mammals.General organisation and characters of Reptiles,Birds and Mammals.General body organization and classification in Sphenodon and Chelonia. Adaptative radiation of reptiles and birds - Adaptations of Cetacea.

(12Hrs)

UNIT III

Structure, development and metamorphosis of Ammoecoetus larva - Comparative anatomy of the brain in vertebrates (Pisces,Amphibia.Repilia,Aves and Mammals). Autonomous nervous system in vertebrates.- Structure and functions. Sense organs in vertebrates: lateral line system and electroreception in fishes.

(12Hrs)

UNIT IV

Vertebrate integument and its derivatives.Appendicular skeleton (Limbs and girdles) in Amphibia, Reptilia, Aves and Mammals.Organs and mechanism of respiration in Pisces, Amphibia, Reptiles, Birds and Mammals.Evolution of heart and aoric arches in vertebrates. Evolution of urinogenital organs in vertebrates.

(12Hrs)

UNIT V

Biological and cultural Evolution of Man. Evolution of Horse.

(12Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	The Biology of Hemichordates and Protochordates	Barrington EJW	Oliver and BoidEdinberg	**2012**
2	The structure and function of nervous tissue	Bourne G.H.	Academic press New York	**2012**

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	The Chordata	Alexander R.N.	Cambridge University Press London	1975
2.	On the Anatomy of Vertebrates: Volume 3	Richard Owen	Cambridge University Press	2011
3.	Biology of Chordates	B.N. Pandey, VartikaMathur	PHI Learning	2018
4.	Comparative Studies of Hearing in Vertebrates	A. N. Popper , R. R. Fay	Springer	2011
5.	Vertebrate Life	F. H. Pough , Christine M. Janis , John B. Heiser	Pearson	1998

JOURNALS:

Journal of vertebrate paleontology
International Journal for Parasitology: Parasites and Wildlife

E-LEARNING RESOURCES:

http://www.ucmp.berkeley.edu/chordata/chordata.html
https://www.britannica.com/animal/chordate
https://opentextbc.ca/biology2eopenstax/chapter/chordates/
https://www.encyclopedia.com
https://www.edge.org/conversation/freeman_dyson-biological-and-cultural-evolution

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	To explain the origin of Chordates
CO 2	To explain the origin of Reptiles, Aves and Mammals
CO 3	To outline the comparative anatomy in Vertebrates
CO 4	To discuss the vertebrates integument and other systems
CO 5	To explain the Evolution of Horse and Man.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	2	2
CO2	2	3	2	2	2	2
CO3	2	3	3	2	2	2
CO4	2	2	2	2	2	2
CO5	2	2	2	2	2	2
AVERAGE	2	2.6	2.2	2	2	2

KEY: **S**TRONGLY CORELATED-3 **M**ODERATELY CORELATED-2 **W**EAKLY CORELATED-1 **N**O CORELATION-0

TEACHING METHODOLOGY:
Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER II
PAPER-V-BIOPHYSICS, BIOSTATISTICS AND BIOINFORMATICS

TOTAL HOURS: 75 **COURSE CODE:** 5P21/2C/BBB

CREDITS : 4 **L-T-P: 3-2-0**

Course Objective

1. To infer the advanced arenas of Microscopy and study the principles and techniques in Histochemistry.
2. To assess the recent trends in separative techniques and the working mechanism of instruments used in the research.
3. To review the students with the physical aspects of Radiation Biology.
4. To integrate conceptual exposure of essential contents of statistics in biology to students.
5. To apply the introductory knowledge with computational tools and biological data base.

COURSE OUTLINE

UNIT I

Microscopy- principle and applications- Fluorescence microscope (FISH), SEM. TEM and Polarizing m+icroscope.Histological techniques- principles of tissue fixation- microtomy- staining and mounting.

(15 Hrs)

UNIT II

Separation techniques- chromatography-principle, types and applications- HPLC/HPTLC and Gas Chromatography. Electrophoresis - principle, types and applications. Ion exchange, Agarose gel and PAGE electrophoresis.General principles and applications of spectroscopy.UV and Atomic Absorption Spectrophotometer, Principles and applications of Flame Photometry. **(15 Hrs)**

UNIT III

Radiation biophysics- ionizing radiation, units of radio activity- exposure and dose, biological effects of radiation: effect on nucleic acid, proteins, enzymes and carbohydrates.

Cellular effects of radiation- somatic and genetic.Autoradiography. -Scintillation counter. **(15 Hrs)**

UNIT IV

General principles of biostatistics- Frequency Distribution.Central tendency, Correlation and Regression.Sampling and Analysis.Sampling theory- Analysis of Variance, Chi square, Non parametric tests (any 2). **(15 Hrs)**

UNIT V

Biology and bioinformatics. Genomics and proteomics, biological databases- National Center for Biotechnology and Informatics (NCBI); European Bioinformatics Institute (EBI) sequence alignment and database searching. Sequencing similarity search tools- BLAST and FASTA. Computational tools for DNA sequencing analysis. **(15 Hrs)**

RECOMMENDED TEXTBOOKS

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Biometry. 4th Edition.	R. R. Sokal And F. J. Rohlf.	W. H. Publisher-Freeman And Company.	2012
2.	An introduction to Biostatistics	N. Gurumani	MJP Publishers	2011

REFERENCE BOOKS

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Introduction to Bio-Statistics	Banerjee Pranab Kumar	S Chand & Company	2007
2.	Biophysics - An Introduction	Rodney Cotterill	Wiley	2014
3.	Principles and Practice of Biostatistics	B Antonisamy, Prasanna S. Premkumar, Solomon Christopher	Elsevier India	2017
4.	Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery	Rastogi	Prentice Hall India Learning Private Limited	2013
5.	Bioinformatics: Principles and Applications	ZhumurGhosh	OUP India	2008

Journals

Biophysical reviews - springer
Indian Journal of Biochemistry and Biophysics –niscair

E- LEARNING RESOURCES

https://nptel.ac.in/courses/103108100/
https://anil.cchmc.org/BioInfoRes.html
https://www.roseindia.net/bioinformatics/bioinformatics_resources.shtml
https://www.od.baumedicine.com/biostatistics
https://blast.ncbi.nlm.nih.gov/Blast.cgi

Course Outcomes:

CO NUMBER	CO STATEMENT
CO 1	Outline the difference between functioning of light microscope and electron microscope.
CO 2	Demonstrate the operating principles of chromatographic separation technique and ability to interpret the working principle of spectrophotometer.
CO 3	Identify the effects of exposure to ionizing radiation at the cellular, organ and body levels and to recognize autoradiography techniques.
CO 4	To compute the mathematical basis and foundation of probability and statistics.
CO 5	To use the need of computational tools and analyze the biological database in open source domain.

Mapping –CORSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	1	3	2	2
CO 2	3	3	1	3	3	3
CO 3	3	2	3	1	2	2
CO 4	2	1	1	3	3	2
CO 5	2	1	1	3	3	2
Average	**2.6**	**1.8**	**1.4**	**4.3**	**4.3**	**3.6**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

Teaching methodology

Lectures by faculty, workout manual and problem solving, group discussions and presentations.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER II

ELECTIVE – II EVOLUTION AND ANIMAL BEHAVIOUR

TOTAL HOURS: 60 **COURSE CODE: 5P21/2E2/EAB**

CREDITS : 3 **L-T-P: 2-2-0**

COURSE OBJECTIVES:

1. To explain the evolutionary process, evidence and patterns
2. To have a basic knowledge on population genetics.
3. To study the evolutionary basis of behaviour in primates, first hominids and man.
4. To learn the principles and mechanism of animal behaviour and their type.
5. To outline the concept of behaviour and territoriality.

COURSE OUTLINE:

UNIT –I

Arguments of evolutionary ideas and evolutionary theories - Evidences for evolution - Fossils and stratification – Indian fossils – living fossils. Natural selection - Basic patterns of evolution and adaptation. **(12 Hrs)**

UNIT – II

Hardy-Weinberg principle and analysis of gene frequencies in natural population -Major factors influencing gene frequencies - Effects of selection and mutation on gene frequencies. - Genetic drift - Molecular evolution - Molecular phylogeny.**(12 Hrs)**

UNIT –III

The origin and evolution of primates -Evolution of anthropoid primates - The first hominids and origin of modern man. **(12 Hrs)**

UNIT - IV

Principles and mechanisms of animal behavior - Territorial behaviour : Size and functions of territoriality – Dominance area – scent marking in vertebrates - Aggressive behaviour : types and causes of aggression – Hormones and aggression. **(12 Hrs)**

UNIT – V

Four propositions of Tinbergen - Individual vs group selection - Cooperation and conflict - Male-male competition and sexual selection -Elaborate ornaments: fisher's hypothesis and handicap hypothesis. Parent-offspring conflict.Sensory system and communication -Signal content and structure.

(12 Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time	Edwin H. Colbert, Michael Morales and Eli C. Minkoff	Wiley; Fifth edition	2011
2.	Animal Behaviour (Ethology)	Agarwal V.K.	S Chand & Company	2010

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Organic Evolution (Evolutionary Biology)	Veer BalaRastogi	Medtech; 13 edition	2017
2.	Introduction to Evolutionary Biology	Mandal	Oxford & IBH Pub. Co	2005
3.	Vertebrates: Comparative Anatomy, Function, Evolution	Kenneth Kardong	McGraw Hill Education; 4 edition	2005
4.	Animal Behaviour	Prasad S. (Author)	CBS Publishers & Distributors; 1st edition	2004
5.	Textbook of Animal Behaviour	K.S.Madhavan	Arjun Publishing House; 1 edition	2018

JOURNALS:

Journal of the Palaeontological Society of India

Journal of Ethology & Animal Science

E-LEARNING RESOURCES:

https://pdfs.semanticscholar.org

https://www.springer.com/gp/book/9783642026232

https://www.nature.com/scitable/knowledge/.../how-does-social-behavior-evolve-132602

https://en.wikibooks.org/wiki/Animal_Behavior/Evolution

https://life.bio.sunysb.edu/bio359/3_11_02.html

COURSE OUTCOMES:

Students will be able to

CO Number	CO STATEMENT

CO1	Examine the overall concept of Fossilization.
CO2	Apply the insights of Hardy Weinberg principle and its application.
CO3	Paraphrase the origin and evolution of primates.
CO4	Diagnose the various behaviour in animal.
CO5	Asses the concepts of aggression, territory and foraging behaviour of animals.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	2
CO2	3	2	3	3	3	3
CO3	3	2	3	2	2	2
CO4	3	2	2	2	2	2
CO5	3	2	2	2	2	3
AVERAGE	**3**	**2**	**2.4**	**2.2**	**2.2**	**2.4**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Smart Class, e-content, Group Discussion, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER II

ELECTIVE – III - MAMMALIAN ENDOCRINOLOGY

TEACHING HOURS: 60Hrs **COURSE CODE: 5P21/2E3/MEY**

CREDITS: 3 **L T P: 2-2- 0**

COURSE OBJECTIVES:

1. To have a clear knowledge on the chemistry, biological functions, mechanism of action of all the hormones and to explain the concepts of feedback mechanism.
2. To explain the organization and functions of Hypothalamo-hypophysial system and to identify its associated disorders.
3. To relate the functions of thyroxine, parathormone and hormones in diabetes
4. To appraise the structure and function of adrenal gland and its regulative mechanism and to compare the biological functions of glucocorticoids and mineralocorticoids
5. To compare the structure and biological functions of testis and ovary.

COURSE OUTLINE:

UNIT I

Introduction to Endocrinology: Classification of hormones based on chemical nature. Classification of endocrine glands according to its function: apocrine, holocrine, and merocrine. Types of cells signaling hormonal secretions: paracrine, autocrine and endocrine.

Mechanism of Hormone action: Nature & mechanism of steroid and protein hormonal action, Hormonal feedback in homeostasis - Negative and positive feedback mechanisms of hormones. **(12Hrs)**

UNIT II

Hypothalamic releasing hormones: Thyrotropin-releasing hormone (TRH), Corticotropin-releasing hormone (CRH), Gonadotropin-releasing hormone (GnRH), Growth hormone-releasing hormone (GRH), Growth hormone release-inhibiting hormone (GRIH) &Prolactin release-inhibiting hormone (PRIH) its localization, chemistry and actions with hypophysis.

Hypophysial hormones- localization, chemistry & biochemical functions of Adenohypophysial hormones: The growth hormone-prolactin group, The glycoprotein hormones (1. Thyroid stimulating hormone (TSH) 2.Follicle stimulating hormone (FSH) 3.Luteinizing hormone (LH) 4. Human chorionic gonadotropin (hCG)) & the pro-opiomelanocortin peptide family (adrenocorticotropic hormone (ACTH), lipotropin - β-LPH endorphins and enkephalins and melanocyte stimulating hormone (MSH). &Neurohypophysial hormones: oxytocin and vasopressin.

Neural Control of hypophysial hormones, Disorders with reference to Gigantism, Acromegaly, Diabetes insipidus. **(12Hrs)**

UNIT III

Thyroid gland: Structure, biosynthesis of Thyroxine, biochemical functions and Mechanism of Action of Thyroid Hormones, Regulation and disorders of thyroid gland - Hypothyroidism, Hyperthyroidism.

Parathyroid gland: structure, biochemical functions, parathyroid hormonal secretion & regulation. Role of parathormone, calcitonin and vitamin D in calcium homeostasis

Endocrine pancreas - structure, hormones and functions.Regulation and Chemistry of insulin and glucagon, disorders of pancreas - Diabetes mellitus. **(12Hrs)**

UNIT IV

Adrenal cortex: Structure, Hormone secretion, Biosynthesis and Control of mineralocorticoid and glucocorticoid secretions. Physiological roles of glucocorticoids and mineralocorticoids

Adrenal medulla: Catecholamine biosynthesis, release and its physiological role.

Disorders with reference to Addisons disease and Cushing's syndrome. **(12Hrs)**

UNIT V

Testis: Organization and Hormone secretion – Chemical structure of testosterone. Physiological role of androgens.

Ovary: Structure – Hormonal secretion - Chemical structure & Physiological role of ovarian hormones. Placental hormones and their functions. **(12Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Endocrinology	Hadley & Levine	Prentice Hall, International Edition.	2000
2.	Williams Textbook of Endocrinology	ShlomoMelmedMBChB MACP, Ronald Koenig, Clifford Rosen, Richard Auchus &Goldfine	Elsevier	2020

REFERENCE BOOKS

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Mammalian endocrinology	Ashoke Kumar Boral	New Central Book Agency (P) Ltd	2016
2.	Mammalian endocrinology	B.N. Yadav	Vishal Publishing Co	2011
3.	Hormones and the Endocrine System: Textbook of Endocrinology	Bernhard Kleine, Winfried G. Rossmanith	Springer Nature	2016
4.	Endocrinology: Hormones and Human Health	Prakash Lohar S.	Mjp Publishers,Zaccheus Entertainment;	2005
5.	Endocrinology, 6th edition	Hadley	Pearson Education India	2009

JOURNALS:

Indian Journal of Endocrinology and Metabolism

General and Comparative Endocrinology

E-LEARNING RESOURCES:

https://archive.org/details/endocrinology00hadl/page/n5/mode/1up

https://www.toppr.com/guides/biology/chemical-coordination-and-integration/mechanism-of-hormone-action/

https://www.tocris.com/research-area/neuropeptides

http://www.pathophys.org/sexhormones/

https://www.health.harvard.edu/diseases-and-conditions/thyroid-deficiency-and-mental-health

https://accessmedicine.mhmedical.com/content.aspx?bookid=1130&sectionid=79751363

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	Outline the chemistry and functioning of hormones and understands its feedback mechanism.
CO 2	Relate the organization and functions of Hypothalamo-hypophysial system with its disorders.
CO 3	Justify the role of thyroid, parathyroid and pancreas in the control of diabetes.
CO 4	Discuss the structure and functioning of the adrenal gland and its associated hormonal disorders.
CO 5	Predict the importance of reproductive hormones in the process of procreation.

MAPPING - COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	2	2	3
CO 2	2	3	3	2	2	3
CO 3	3	3	2	2	2	3
CO 4	3	3	2	2	2	3
CO 5	3	3	3	3	3	3
Average	**2.8**	**3**	**2.4**	**2.2**	**2.2**	**3**

KEY: **S**TRONGLY CORELATED - 3 **M**ODERATELY CORELATED - 2 **W**EAKLY CORELATED - 1 **N**O CORELATION - 0

TEACHING METHODOLOGY:

Lectures by faculty, practical demonstration, guest lectures by eminent speakers, group discussions and presentations.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	A-5X8 marks	500	40	100
K4, K5	B-3x20 marks	1500	60	

SEMESTER II

PRACTICAL I – INVERTEBRATA, CHORDATA AND MICROBIOLOGY

COURSE CODE:5P21/2C/MP1

TOTAL HOURS: 120
CREDITS : 4 L-T-P:0-0-8

COURSE OBJECTIVES:

1. To identify the general and specific characteristics of the different phyla from Protozoa to Echinodermata.
2. To dissect and demonstrate the Digestive, Nervous and Reproductive systems of Invertebrates.
3. To identify the general, specific characteristics and level of organization in different classes of chordate.
4. To dissect and demonstrate the vertebrates.
5. To differentiate, identify and to isolate bacteria by simple and differential staining methods.

INVERTEBRATA

1. Identification and study of selected Protozoans and Helminthes of medical importance.
2. Identification and study of sections of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study of larval forms from all major phyla of invertebrates.
4. Identification and study of invertebrate fossils (specimens).
5. Dissection of digestive, nervous and reproductive systems in Gryllotalpa
6. Dissection of digestive and nervous systems in Scorpion
7. Dissection of Nervous system in 1. Pila 2. Prawn

8 Mounting of Pedicellariae, Aristotle lantern in Sea Urchin and mounting of the sting of honey bee.

CHORDATA

1. Identification of important Prochordates, South Indian fishes, Amphibians, Reptiles, Birds and Mammals.
2. Dissection of aortic arches in Shark and Mullet.
3. Mounting of brain of fowl.

MICROBIOLOGY

1.IDENTIFICATION

a. *Staphylococcus aureus*
b. *Escherischia coli*
c. *Rhizopus*
d. *Aspergillusniger*
e. *Aspergillus flavus*
f. *Penicillium*
g. *Nostoc*
h. *Oscillatoria*
i. *Volvox*

2.CULTURE MEDIUM AND PREPARATION

i. Preparation of peptone water
ii. Preparation of nutrient broth
iii. Preparation of solid media.
1. Slant
2. Stab
3. Plate.
4. Simple and Differential staining of bacteria.
5. Identification of bacteria in Milk – Gram staining (Lactobacilllus and Streptococcus)
6. Identification of Algae present in pond water – Oscillatoria, Chlorella, Nostoc.

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Manual of Zoology: v. 1 & 2	Prof. EkambaranathaAvyyar &Prof. Anantakrishnan	Viswanathan, S., Printers & Publishers Pvt Ltd	2009
2.	Microbiology: A Laboratory Manual	la Carte Edition (11th Edition)	Pearson; 11 edition	2016

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Advanced Zoology Practical	Sinha. J, Chatterjee. A. K, Chattopadhyay. P	ArunabhaSen Books and Allied (P) Ltd	2011
2.	A Textbook of Practical Zoology Vertebrate	Lal S. S.,	Rastogi Publication	2004
3.	A Textbook of Practical Zoology Invertebrate	Lal S. S.,	Rastogi Publication	2004
4.	General Zoology Laboratory Manual	J.E. Wodsedalek Charles F. Lytle &	McGraw Hill Higher Education	2000
5.	Microbiology A Laboratory Manual	James G. Cappuccino, Chad T. Welsh, Cappuccino / . Welsh	Pearson	2016

E-LEARNING RESOURCES:

https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/phylum-arthropoda

www.nuffieldfoundation.orl-biolg/practicaogy
www.nature.com
https://microbiologysociety.org
https://academic.oup.com

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	To explain the unique characters of Protozoa to Echinodermata.
CO 2	To dissect and demonstrate the Digestive, Nervous and Reproductive systems of Invertebrates.
CO 3	To describe unique characteristics of Fishes, Amphibian, Reptiles, Aves and Mammals.
CO 4	To dissect and demonstrate the aortic arches in Shark and Mullet
CO 5	To identify and study some of the common microbes, bacterial identification with gram staining method.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	3	3	3	2
CO2	3	2	2	2	3	2
CO3	2	3	2	3	3	2
CO4	3	2	2	3	2	3
CO5	3	3	2	3	2	2
AVERAGE	**2.6**	**2.6**	**2.2**	**2.8**	**2.6**	**2.2**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:
Demonstration,Dissection ,Observation, lable the sketches,identify and classification and relate the homologous and analogous structure .

SEMESTER II

PRACTICAL II -MOLECULAR BIOLOGY, GENETICS, BIOPHYSICS AND BIOSTATISTICS

TOTAL HOURS: 120 **COURSE CODE:5P21/2C/MP2**

CREDITS : 4 **L-T-P:0-0-8**

COURSE OBJECTIVES:

To Enable the students

1. To apply the techniques of micrometry, histochemistry and differential count.
2. To acquire knowledge on the techniques involved in drosophila culture and to identify the mutants.
3. To perceive the techniques of karyotyping.
4. To demonstrate the principle and applications of spectrophotometer and electrophoresis.
5. To solve the problems in statistics and apply the same in biological research.

CORSE OUTLINE:

MOLECULAR BIOLOGY

1. Cytological techniques

Micrometry: Microscopic calibration and Measurements of cell size using ocular and stage micrometers.

2. Study of different types of cells

Blood cells –Differential count in Human

Histochemical techniques

Demonstration: Fixation, Dehydration, Embedding, staining (vital staining) and Mounting.

Histochemicallocalisation of

a. Lipids
b. Proteins

Genetics

1. Preparation of culture medium for Drosophila.
2. Observation of Drosophila in culture medium.
3. Identification of sex in Drosophila. Development and life cycle.

4. Identification of Drosophila mutants.

   1. Yellow body 2. White eye 3.Vestigial wing 4.cutwing 5. Rotated abdomen

   6. Curled wing 7. bi-thorax 8. Bar eyes 9. Cinnabar.

5. Preparation of human karyotypes. Analysis of normal and abnormal karyotypes. Down's syndrome and Klinefelter's syndrome.

6. Genomic imprinting analysis- PraderWilli syndrome.

7. Mitochondrial diseases and modes of inheritance.

8. Gene Therapy – ADA deficiency and CFTR.

Biophysics

1. Principle and application of Spectrophotometer

   - Determination of proteins

2. Principle and application of Electrophoresis

Biostatistics

1. Construction of bar diagram - simple, component and percentage
2. Construction of histogram and pie diagram
5. Measures of central tendency

   a) Calculation of mean for continuous series -direct method.

   b) Calculation of median for continuous series.

   c) Calculation of mode for continuous series.

6. Measures of dispersion: calculation of standard deviation – direct method.

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Introduction to Experimental Biophysics (Set): Textbook and Lab Manual	Jay L. Nadeau	CRC Press	2015
2.	Cell and Molecular Biology: A Lab Manual	Chaitanya K.V	Prentice Hall India Learning Private Limited	2013

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology	M.M. Trigunayat	Scientific Publishers	2019
2.	Laboratory Procedures In Haematology Manual	Mehdi	Jaypee Brothers Medical Publishers	2006
3.	Drosophila: A Laboratory Manual	Michael Ashburner	Cold Spring Harbor Laboratory Press,U.S.	1999
4.	Practical Use of Biostatistics	AbhiramBehera	CRC Press	2016
5.	Introduction to Experimental Biophysics	Jay L. Nadeau	CRC Press	2015

E-LEARNING RESOURCES:

https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology
https://paramedicsworld.com/biochemistry-practicals/demonstration-of-spectrophotomete
https://www.cambridge.org/core/series/practical-guides-to-biostatistics-and-epidemiology/B8A2E84D28744441DF3DB4BB407BEF23
https://www.springer.com/gp/book/9783540543275
https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Labor

COURSE OUTCOMES:

Students will be able to

CO NUMBER	CO Statement
CO 1	Equipped in handling micrometer, preparingmicroslides and in identifying different types of blood cells.
CO 2	Understands the techniques of drosophila culture ,karyotyping, genomic imprinting and applications of gene therapy.
CO 3	Understands the techniques of spectrophotometer and electrophoresis and uses it in future research program.
CO 4	Use the theories of statistics in compiling in biological results.
CO 5	To predict the Measures of central tendency

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	2	3
CO2	2	3	3	3	2	3
CO3	3	3	2	3	2	3
CO4	3	2	3	2	3	3
CO5	2	3	3	3	3	3
AVERAGE	**2.6**	**2.8**	**2.8**	**2.8**	**2.4**	**3**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Demonstration, Observation, Problem solving in statistics.

SEMESTER III
PAPER VI- ANIMAL PHYSIOLOGY

TOTAL HOURS : 60 **COURSE CODE:5P21/3C/APY**
CREDITS : 4 **L-T-P :3-1-0**

COURSE OBJECTIVES:

1. To explain the complex metabolic process involved in digestion, classify the blood components and associate the various events in the functioning of the heart.
2. To appraise the components of the respiratory system and their role in respiration.
3. To illustrate the mechanisms of urine formation and its regulation and to associate its importance in osmoregulation. To relate the various adaptive mechanisms in poikilo&homeothermal animals.
4. To interpret the complex mechanisms in neurotransmission and muscle coordination.
5. To state the physiological mechanism involved in photo &auditory reception, colour change and bioluminescence.

COURSE OUTLINE:

UNIT I

Physiology of Digestion – Intracellular and extracellular digestion – Balance diet – Digestive system with special reference to Aves, Ruminants and other Mammals – Physiology of Digestion: Mechanical aspects, Chemical aspects - Digestive enzymes - Process of Digestion: Digestion and absorption of Carbohydrate, Protein, Fat

Organs and Mechanism of Respiration : Aquatic respiration, Aerial respiration, Terrestrial respiratory - Physiology of respiration: transportation of Respiratory gases in blood, transportation of carbon dioxide – Exchange of gases between blood and tissues - Respiratory Quotient - Respiratory pigments **(12 Hrs)**

UNIT II

Circulatory fluids in Animals: Hydrolymph, Hemolymph, Blood and Lymph - Structure and composition of blood: Plasma, Blood corpuscles, Blood Platelets –Functions of blood – Types of circulation – Synthesis of Haemoglobin in Erythrocytes – Physiology of circulation- Blood groups and Coagulation of Blood - Conducting system of Heart, Heart Beat, Blood Pressure, Pulse, ECG **(12 Hrs)**

UNIT III

Excretion – Excretory Organs in Invertebrates and Vertebrates – Accessory Excretory Organ, Ammoniotelic, Ureotelic and Uricotelic – Structure of Nephron - Physiology of Excretion - Formation of Urine - Counter Current System for Concentration of Urine – Osmoregulation – Osmoregulation in Non- chordates and Chordates – Salt - Water Balance in Vertebrates. **(12 Hrs)**

UNIT IV

Nervous Tissues – Structure of Neuron –Types - Nerve and Nerve termination – Types of synapses – Physiology of Nerve system - Transmission of an impulse across a Nerve fibre –Reflex action.

Muscle – Types of muscles - Striated , nonstriated – Cardiac - Contractile proteins – Enzymes of Myofibrils - Mechanism of muscle contraction – Role of Calcium and vitamins in muscle contraction - Energy Sources for Muscle Contraction - Contraction of smooth muscles and Cardiac muscles – fatigue, twitch, summation, tetanus, and Rigor mortis **(12 Hrs)**

UNIT V

Receptors – Classification of Receptors – Transduction of Sensory Stimulus into Nerve Impulse – Somatic Senses - Special Senses – Photoreceptors – Mechanoreceptors – Chemoreceptors – Thermoreceptor - Rheoreceptors - Bioluminescence: Physiology and Significance. **(12 Hrs)**

RECOMMENDED BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Comparative Animal Physiology	C.Ladd Prosser	Thomson Learning	1991
2	Animal Physiology	Dr.P.S.verma ,B.S.Tyagi&V.K.Agarwal	S.Chand Publishing Company	2000

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	A Text Book Of human Physiology	H.S.Ravikumarpatil,H.k.Makari,H.Gurumoorthy&S.V.Sowmya	I.K.International Publishing House Pvt.,Ltd.	2009
2	Physiological Basis Of Medical	Best And Taylor	Practice. Wilkins Co Mcgraw Hill, New Dellhi	2005
3	Text book of Medical Physiology	Guyton & Hall	Elsevier India	2014

4	Animal Physiology and Biochemistry	Dr.Kaushal Kumar &Dr.Anil.D.Srivastava	S.Chand Publishing company pvt.,Ltd	2016
5	Animal Physiology	Knut Schmidt Nielsen	Foundation books	2006
6	Animal Physiology	B.S. Tomar, Neera Singh	PragatiPrakashan Publication	2016

JOURNALS:

Journal of Medical Physiology and Therapeutics
Journal of Animal Physiology and Animal Nutrition

E-LEARNING RESOURCES:

https://courses.lumenlearning.com>digestive system/Anatomy and Physiology
https://www.ck12.org>system
https://www.opentextbc.chapter>Basic
https://www.dmu.edu>medterms
https://www.lung.ca>lung .infor>respiratory system

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	Outline the metabolism of carbohydrates, protein & lipids and physiology of Circulation.
CO 2	Explain the physiological process of respiration and discuss the respiratory adaptations.
CO 3	Idenify the importance of excretion,osmoregulaion and thermoregulation.
CO 4	Explain the mechanism of neurotransmission of muscle co-ordination.
CO 5	Discuss the physiological mechanisms involved in photo & auditory reception,colour changes and bioluminescence.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PO	PSO 1	PSO 2	PSO 3	PSO4	PSO5	PSO6
CO 1	3	3	2	2	2	2
CO 2	3	3	3	3	3	2
CO 3	3	3	3	2	2	2
CO 4	3	3	3	3	3	2
CO 5	2	3	3	2	2	2
Average	**2.8**	**3**	**2.8**	**2.4**	**2.4**	**2.0**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	
K4,K5	**B-3x20 marks**	**1500**	**60**	**100**

SEMESTER III

PAPER VII- ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION

TOTAL HOURS: 60 **COURSE CODE: 5P21/3C/EBC**
CREDITS : 4 **L-T-P: 3-1-0**

COURSE OBJECTIVES:

1. To develop and appreciation of the importance of biosphere & biogeochemical cycle and the conservation of water.
2. To examine the causes effects and mitigation of bioaccumulation and global warming.
3. To explain the concept of disasters and disaster management.
4. To evaluate the importance and exploitation of Mineral resources for sustainable life.
5. To analyze various biodiversity Plights

COURSE OUTLINE:

UNIT- I

Basic concept and Scope of Environmental Biology - Biosphere and Biogeochemical cycles. Environmental monitoring and impact assessment.Environmental and sustainable development. Water conservation: Rain water harvesting - water shed management.

(12 Hrs)

UNIT- II

Causes - effects and remedial measure of Air pollution - Water pollution – Noise pollution – Radioactive - Thermal and Agriculture pollution. Basic concepts of Bioaccumulation - Solid waste management - Global warming - Cause of global warming, Impact of global warming – Afforestation - Reduction in the use of CFCS.

(12 Hrs)

UNIT- III

Disaster management: Floods – Earthquake – Cyclones – Landslides. Natural Resource - Forests of India - Use and over exploitation of forests - Timber extraction. Land degradation - Use and over utilization of surface and ground water - Floods. Drought dams - benefits and problems.

(12 Hrs)

UNIT- IV

Mineral Use and exploitation: Environmental effect of extracting and using mineral resources - World food problem - Effects of modern agriculture and overgrazing - Conventional and non - conventional energy resources - alternate energy source - Equitable use of resources for sustainable life.

(12 Hrs)

UNIT- V

Biodiversity crisis – habitat degradation - poaching of wild life - Environmental legislation. Socio economic and political causes for loss of biodiversity - Conservation of Biodiversity: *In situ* and *ex situ* conservation of biodiversity - Hot spots of Biodiversity.

(12 Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Fundamentals of Ecology	Eugene Odum	Cengage publication; 5 edition	2017
2.	Elements of Ecology 8 edition	Smith	Pearson Education India;	2014

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Biodiversity Conservation: Cuurrent Status and Future Strategies	Dushyant Kumar Sharma,	Write And Print Publications	2017
2.	Ecology. VI Edition	Krebs, C. J.	Benjamin Cummings	2001
3.	Ecology. V Edition.	Ricklefs, R.E.,	Chiron Press	2000
4	Ecology: The Experimental Analysis of Distribution and Abundance; Sixth edition	KREBS	Pearson Education India	2016
5	Biodiversity; 2nd Ed. Edition	Kevin J. Gaston, John I. Spicer ,	Blackwell	2004

JOURNALS:

International Journal of Environmental Science and Technology
Journal of Environmental Biology

E-LEARNING RESOURCES:

https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=79946&printable=1
https://www.khanacademy.org/science/biology/ecology/biogeochemical-cycles/a/introduction-to-biogeochemical-cycles
http://ecoursesonline.iasri.res.in/mod/page/view.php?id=4527
https://www.techglads.com/cse/sem3/forest-resources-use-and-overexploitation/
http://www.economicsdiscussion.net/notes/conventional-and-non-conventional-sources-of-energy/2177

COURSE OUTCOMES:

Students will be able to

CO NUMBER	CO STATEMENT
CO 1	To discuss on the importance of biosphere and its conservation
CO 2	To identify the basic issues of pollutions (Air, Water, Noise, radioactive thermal and agriculture pollution)
CO 3	To apply the knowledge on disaster management.
CO 4	To discuss the importance and exploitation of Mineral resources and energy resources.
CO 5	To analyse various biodiversity predicaments.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	3
CO2	2	3	2	3	3	2
CO3	2	3	2	3	3	2
CO4	2	3	2	3	3	3
CO5	3	2	2	2	2	2
AVERAGE	2.4	2.6	2.2	2.6	2.6	2.4

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER III
PAPER VIII – IMMUNOLOGY

TOTAL HOURS: 60 **COURSE CODE: 5P21/3C/IMM**
CREDITS : 4 **L-T-P: 3-1-0**

COURSE OBJECTIVES:

1. To identify the cells, tissues and organs involved in antigen antibody interactions.
2. To classify and explain the structure of immunoglobulin and the molecular mechanism of immunoglobulin gene rearrangements. To appraise the immune functions of the complement system and the Major Histocompatibility Complex.
3. To explain the maturation and differentiation of immune cells at the molecular level and the response of effector molecules in immune reactions.
4. To distinguish the types of hypersensitivity,to outline the autoimmune disorders and state the concepts of transplantation immunology.
5. To give examples and explain certain infectious diseases in humans and to appraise the importance of immunoprophylaxis. To pronounce the principles. mechanisms and applications of immunotechniques.

COURSE OUTLINE:

UNIT- I

Immune system - innate and adaptive immunity.Cells and organs of immune system – hematopoiesis, primary and secondary lymphoid organs.Antigens and antibodies – antigenicity, immunogenicity, antigen – antibody interactions, superantigens, antibody diversity. **(12 Hrs)**

UNIT- II

Organization of immunoglobulin genes – antibody structure, heavy, light, kappa, lambda; chain gene rearrangements. Complement system – classical, alternative and lectin pathways, regulation of complement system, biological consequences of complement activation. Major Histocompatibility Complex (MHC) - general organization and inheritance of the MHC, MHC molecules and genes, cellular distribution and regulation of MHC expression. **(12 Hrs)**

UNIT- III

T cells - maturation, activation and differentiation, T cell receptors. B cells - maturation, activation and differentiation, B cell receptors. Cytokines - properties of cytokines, cytokine receptors, cytokine-related diseases, therapeutic uses of cytokines and their receptors. Cell mediated cytotoxic responses – effector mechanisms, leukocyte activation and migration.

(12 Hrs)

UNIT- IV

Hypersensitivity reactions – types, prevalence, factors, mechanisms of type I to IV hypersensitivity reactions.Immune tolerance and Autoimmunity – organ specific autoimmune diseases, treatment of autoimmune diseases.Transplantation immunology – blood antigens, transplantation rejection, graft rejection, familial grafting, tissue typing, cross matching, immune suppression. **(12 Hrs)**

UNIT- V

Immune response to infectious diseases– bacterial, fungal, viral, parasitic diseases and Immune deficiency - AIDS. Vaccine production, Reverse Vaccinology, Immune therapies..Applications of immunology and immune techniques –, Rapid antigen diagnostic test, Hemagglutination Inhibition Assay (HIA). **(12 Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	A Text book of Immunology	R. C. Kuby*et al*.	Macmillan learning ,8th edition.	1994
2.	Immunology	Roitt, Brostoff and D. Male.	Willey Black well	2017

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Fundamental immunology	William Paul	Lippincott Williams & Wilkins	2013
2.	Immunology	Tizzard.	Elsvier publications	2018
3	Cellular and Molecular Immunology 9th Edition	Abul.K.Abbas, A.H.Lichtman& Shiv Pillai	Elsvier publications	2019
4	Encyclopedia of Immunology	Ivan Roitt& Peter Delves	Elsvier publications	1998
5.	How the immune system works	Lauren .M. Sompayrac	Blackwell Publishers	1999

JOURNALS:

Journal of Clinical Immunology
Indian Journal of Immunology and Respiratory Medicine

E-LEARNING RESOURCES:

https://www.medicalnewstoday.com/articles/320101.php
www.biologydiscussion.com/genetics/organisation-of-immunoglobulin/genes
https://nptel.ac.in/corses/102103038/download/module3.pdf
www.immunopaedia.org.za/immunology/archieve/typei-iv-hypersensitivity
https://www.scribd.com/doc/53764085/immunotechniques

COURSE OUTCOMES:
Students will be able to

CO NUMBER	CO STATEMENT
CO1	Evaluates the integrated functioning of the cells, tissues and organs of immune system and gains in depth knowledge of the Ag-Ab interactions at the molecular level.
CO2	Identifies the immunoglobulin structure and gene organization, and gains an insight into the complement system, MHC and its regulation.

CO3	Discuss the molecular mechanisms of T cell and B cell maturation and the structure of the receptors and the effector molecules and their therapeutic implications.
CO4	Predicts the immunological response to various types of hypersensitivity and to outline the concepts involved in autoimmune disorders.
CO5	Predicts the nature of infectious diseases based on the immune responses elicited by our body. Formulate a vaccination schedule and identify the uses of immunotechniques.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	2	3	3	2
CO4	3	3	2	3	3	2
CO5	3	3	2	3	3	2
AVERAGE	**3**	**3**	**2.2**	**3**	**3**	**2**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	
K4,K5	**B-3x20 marks**	**1500**	**60**	**100**

SEMESTER III

ELECTIVE -IV-RECOMBINANT DNA TECHNOLOGY

TOTAL HOURS: 60 **COURSE CODE: 5P21/3E4/RDT**

CREDITS : 3 **L-T-P: 2-2-0**

COURSE OBJECTIVES:

1. To infer knowledge on the importance of molecular biology and rDNA technology.
2. To apply molecular biology tools in gene cloning, manipulation and the uses of r DNA technology.
3. To gain knowledge about various hybridization techniques.
4. To appraise the variants of DNA sequencing methods.
5. To develop the students to work in biotech sector including pharmacy, food, agriculture and biomedical.

COURSE OUTLINE:

UNIT- I

Introduction to recombinant DNA technology, General strategies of recombinant DNA technology and gene cloning – Restriction digestion, ligation – types of ligation, selectable marker and reporters used in rDNA technology. Genomic and cDNA libraries – chromosome walking and jumping. **(12 Hrs)**

UNIT- II

Vectors in gene cloning, Types of vectors and choice of vectors. Plasmids – pBR 322, pBR 327, pUC 8. cosmids, lambda phage vectors – M13 phage vectors, phagemids, shuttle vectors, YACS, BAC. Enzymes of gene cloning – restriction endo nucleases, exonucleses, DNA modifying enzymes, polymerases, transferases, kinases, ligase. **(12 Hrs)**

UNIT- III

Methods of transferring recombinant DNA to different host cells, Screening for transformants, Characterisation of transformants, Selection of recombinants. Nucleic acid hybridization techniques, Molecular Probe and its construction: probe labeling – nick

translation, end labeling, random primer labeling – Expression of cloned genes in prokaryotes and eukaryotes. **(12 Hrs)**

UNIT- IV

DNA sequencing - first generation sequencing methods – Maxam and Gilbert method, Sangers – dideoxy sequencing, pyrosequencing, automated sequencing. PCR and its variants.DNA microarray. **(12 Hrs)**

UNIT-V

Applications of Biotechnology in prenatal diagnosis – gene therapy: somatic and germline. pharmaceutical products – Humilin.Crop management – pesticide and herbicide resistance. Transgenic animals: gene silencing and GM foods. **(12 Hrs)**

RECOMMENDED TEXT BOOKS

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Principles of Genome Analysis And Genomics. 7th Edition	Prirose S., Twyman R.,	Blackwell Science Ltd.	2013
2.	Biotechnology: A Problem Approach 1	Pranav Kumar and Usha Mina	Pathfinder Publication	2015

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Molecular Biotechnology Principles & applications of recombinant DNA, 5th edition	Bernard R. Glick, Cheryl L. Patten	ASM Press	2017
2.	Modern Industrial Microbiology & Biotechnology 2nd edition	NdukaOkafor, Benedict C. Okeke	CRC Press	2017
3.	Medical Biotechnology	JuditPongrancz, Mary Keen	Elsevier Health – UK	2009
4.	Recombinant DNA Technology	Keya Chaudhuri	The Energy & Resources Institute, TERI	2013
5.	Environmental Biotechnology: Basic	InduShekahr Thakur	IK International Publishing House	2011

	concepts & applications. 2nd edition			

JOURNALS:

Review in Molecular Biotechnology
Indian Journal of Biotechnology

E-LEARNING RESOURCES

https://nptel.ac.in/courses/104108056/
https://www.toppr.com/guides/biology/biotechnology
http://www.biology.arizona.edu/molecular_bio/problem_sets/Recombinant_DNA_Technology/Recombinant_dna.html
https://www.mybiosource.com/learn/gene-transfer-technique/
https://www.sciencedirect.com/science/article/pii/B9780128092316000053

COURSE OUTCOMES:

Students will be able to

CO NUMBER	CO STATEMENT
CO 1	To outline the scope in emerging field of biotechnology i.e. Recombinant DNA Technology
CO 2	Apply various enzymes, vectors and hosts in molecular cloning experiments and perform how to construct cDNA libraries
CO 3	Select the differents Hybridization technique
CO 4	Use the methods of DNA sequencing and DNA microarray technique.
CO 5	Explain comprehensive knowledge about transgenic technologies and GM foods

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	3	3	3
CO 2	3	3	2	3	2	3
CO 3	3	3	2	3	1	3
CO 4	3	3	2	3	1	3
CO 5	3	3	3	3	1	2
Average	**3**	**3**	**2.2**	**3**	**1.6**	**2.8**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY

Lectures by faculty, practical demonstration, guest lectures by eminent speakers, group discussions and presentations.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER IV

PAPER-IX- DEVELOPMENTAL BIOLOGY

TOTAL HOURS: 75 **COURSE CODE: 5P21/4C/DBY**

CREDITS : 4 **L-T-P: 3-2-0**

COURSE OBJECTIVES:

1. To explain various methods of sexual and asexual reproduction in primitive organism.
2. To study the mechanism of metamorphosis and vitellogenesis.
3. To explore the concepts of gametogenesis and fertilization at molecular level.
4. To formulate the techniques involved in ART.
5. To outline the different contraceptive techniques.

COURSE OUTLINE:

UNIT- I

Various methods of asexual and sexual reproduction in Protozoa -Morphogenesis and hormonal control. -Metamorphosis in insects: Partial and complete metamorphosis, metamorphic forms nymph, larvae and pupae - Mechanism of vitellogenesis in insects. Neurohormonal control of fish reproduction and mechanism of vitellogenesis. Metamorphosis in Amphibia: morphogenetic and biochemical mechanism, hormonal control.

(15Hrs)

UNIT- II

Testis and Seminiferous tubules.Sertoliand Leydigcells structure and functions in humans Gametogenesis-Spermatogenesis-Ultra-structure of human spermatozoa, Hormonal control of spermatogenesis - semen- biochemical composition and sperm abnormality: Azoospermia, oligozoospermia and asthenozoospermia.Sperm capacitation and decapacitation- molecular mechanism and significance – oogenesis- Mechanism of oogenesis, biochemical events, hormonal regulation. Female reproductive disorders: Amenorrhea and Polycystic ovary.

(15Hrs)

UNIT- III

Fertilization in humans Cytological and molecular events of fertilization –Cleavage and early embryonic development - Patterns and molecular mechanism of cleavage-blastula formation- gastrulation and formation of germ layers- Implantation in

humans.Foetal membranes- types, structure and functions - Pheromones and sexual behavior in mammals - Molecular induction (Morphogenetic gradients) and organizer concept. **(15Hrs)**

UNIT- IV

Cryopreservation of gametes, embryo and test-tube baby - In vitro fertilization (IVF) and its significance - Multiple ovulation and embryo transfer technology (MOET) - Application of embryonic stem cells, clinical significance. Embryonic sexing, cloning, screening for genetic disorder diagnosis (ICSI, GIFT etc.), Cloning of animals by nuclear transfer. **(15Hrs)**

UNIT- V

Immunocontraception- fertilization, inhibition and pregnancy termination - Classical contraceptive techniques: Physical, chemical, surgical and IUCD devices. Anti-androgen and anti-spermiogenic compounds (LDH-CY and SP-10).

(15 Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Chordate Embryology	Verma P.S and Agarwal V.K	S Chand; Reprint of 1975 first edition edition	2010
2.	An Introduction to Embryology	B.I. Balinsky	Cengage Learning India; 5 edition	2012

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	An Introduction to Embryology	A.K. Berry	Emkay Publications; 2002 edition	2016
2.	Developmental Biology	Scott F. Gilbert	Sinauer Associates Inc.,U.S.; 8th Revised edition edition	2006
3.	Langman's Medical Embryology	Sadler	Wolters Kluwer India Pvt. Ltd.; Thirteenth edition	2016
4.	Developmental Biology	K.S.Madhavan	Arjun Publishing House; 1 edition2	2018

5.	Developmental Biology	M.A. Subramanian	MJP Publishers	2012

JOURNALS:

Indian journal of experimental biology
Journal of developmental biology

E-LEARNING RESOURCES:

https://www.ncbi.nlm.nih.gov/books/NBK225682/
https://www.journals.elsevier.com/developmental-biology/recent-articles
https://www.the-scientist.com/tag/developmental-biology
https://www.hindawi.com/journals/bmri/2014/868196/
https://www.cell.com/trends/biochemical-sciences/fulltext/S0968-0004(18)30154-3

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO1	Relate the different reproductive pattern in protozoa.
CO2	Determine the mechanism behind metamorphosis and vitellogenesis in insects.
CO3	Organizes the molecular events pertaining to fertilization and gametogenesis.
CO4	Asses the strategies of various assistant reproductive techniques.
CO5	Infer in-depth knowledge in immuno-contraception.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1
CO2	3	3	3	2	3	2
CO3	3	3	2	2	3	2
CO4	3	2	2	3	3	3
CO5	3	2	2	2	2	2
AVERAGE	**3**	**2.4**	**2**	**2**	**2.4**	**2**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Smart Class, e-content, Group Discussion, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER- IV
PAPER X- BIOCHEMISTRY

TOTAL HOURS: 75 **COURSE CODE: 5P21/4C/BIO**

CREDITS : 4 **L-T-P: 3-2-0** **COURSE**

OBJECTIVES:

1. To demonstrate foundation on different chemical bonds and their forces in bio molecules
2. To acquire specialized knowledge on pH,Buffer and Acid base regulation in Life processes.
3. To discuss the concept of thermodynamics and its biochemical principles. .
4. To focus on the fundamental chemical principles of carbohydrates, amino acids , lipids, enzymes and its classifications, structure, metabolic pathway and its functions.
5. To classify and illustrate metabolism of fatty acids and nucleic acids. To critically analyse and understand xenobiotics and related concepts.

. **COURSE OUTLINE:**

UNIT I:

Chemical bonds - covalent bonds, hydrogen bonds, disulphide bonds- Forces between molecules- Electrostatic force, Vanderwal's force, Hydrophilic and Hydrophobic force Biological importance. pH and Acid - Base balance. Henderson - Hasselbach equation - Acidosis, Alkalosis. Buffers – Buffer systems of blood- biological importance, Laws of thermodynamics, entropy, enthalpy, free energy - Reversible thermodynamics and irreversible thermodynamics **(15Hrs)**

UNIT- II

Carbohydrates – Classification and structure – Metabolism – Glycolysis, Citric acid cycle, Glycogenesis, Glycogenolysis and Gluconeogenesis, Bioenergetics – Electron transport chain and Oxidative phosphorylation. Synthesis of ATP **(15Hrs)**

UNIT- III

Proteins – Classification of proteins and Aminoacids - Primary, Secondary, Tertiary and Quaternary structures of proteins, Protein folding. Ramachandran plot.Protein metabolism Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.Enzymes – Nomenclature –

Classification of enzymes - Mechanism and Regulation of enzyme action. Enzyme kinetics – MichaelisMenten Hypothesis –Line Weaver Burk equation - Factors affecting enzyme action.

(15Hrs)

UNIT- IV

Lipids – Classification of lipids- Functional importance of membrane lipids and steroids, cholesterol biosynthesis- Fatty acid metabolism- Biosynthesis of fatty acids - β - oxidation and Omega Oxidation of fatty acids. Ketogenesis Energetics of fatty acid metabolism .

Nucleotide metabolism-biosynthesis and structure of purine and pyrimidine bases .Catabolism of nucleotides and their pathways.

(15Hrs)

UNIT- V

Metabolism of Xenobiotics - detoxification and biotransformation – Phase I reactions oxidation, reduction, Hydrolysis – Phase II conjugation reaction – Glucuronic acid, mercapturic acid, Glutathione sulphate, acetate and methyl group. Phase III permeable membrane transporters P-glycoprotein and regulation of biotransformation by xenobiotic receptors.

(15Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Fundamentals of Biochemistry	J L Jain , Sunjay Jain , Nitin Jain	S Chand; Seventh edition	2016
2.	Satyanarayana U and Chakrapani U	Essentials of Biochemistry	Book and Allied (P) Ltd.	2009

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Biochemistry, VI Edition,	Berg, J.M., Tymoczko, J.L. and Stryer, L.	W.H. Freeman andCo., New York	2007
2.	Lehninger's Principles of Biochemistry,	Cox, M.M and Nelson, D.L	VEdition, W.H. Freeman and Co., New York.	2008
3.	Protein Structure and Molecular Properties	Creighton, T.E.	W.H. Freeman & Co.	1992

4.	Fundamentals of Biochemistry	J L Jain , Sunjay Jain , Nitin Jain	S Chand; Seventh edition	2016
5.	Instant Notes in Biochemistry, II Edition,	Hames, B.D. and Hooper, N.M.	BIOS Scientific Publishers Ltd., U.K.	2000

JOURNALS:

Biochemical Journal

Journal of Cellular Biochemistry

E-LEARNING RESOURCES:

http://www.ncert.nic.in/ncerts/l/kech104.pdf

https://chem.libretexts.org/Courses/University_of_Kentucky/UK%3A_General_Chemistry/07%3A_Chemical_Bonding_and_Molecular_Geometry

https://courses.lumenlearning.com/introchem/chapter/the-three-laws-of-thermodynamics/

https://opentextbc.ca/anatomyandphysiology/chapter/24-1-overview-of-metabolic-reactions/

http://www.organic.lu.se/education/Ekosystemteknik/molecular_cell_biology/5_Metabolism.pdf

COURSE OUTCOMES:

CO NUMBER	**CO STATEMENT**
CO 1	To list down the advantages and importance of chemical bonding that occurs in living organisms.
CO 2	To calculate and explain the mechanism of buffer and acid base
CO 3	To comprehend & to correlate how the living organisms exchange energy and matter with the surroundings and various biochemical changes that obeys thermodynamic laws.
CO 4	To recognize and describe the structure, synthesis ,role in metabolic pathways and their regulation and functioning of carbohydrates, amino acids , lipids, enzymes.

CO 5	To differentiate the nucleic acid and importance of xenobiotics at biochemical level.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	2	3
CO2	3	2	2	2	2	3
CO3	3	3	3	3	3	3
CO4	3	3	2	3	3	3
CO5	3	3	2	3	3	3
AVERAGE	**3**	**2.8**	**2.2**	**2.8**	**2.6**	**3**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER IV

PAPER XI- AQUACULTURE

TOTAL HOURS: 75 **COURSE CODE: 5P21/4C/AQU**

CREDITS : 4 **L-T-P: 3-2-0**

COURSE OBJECTIVES:

1. To describe the fishery resources in India.
2. To compare the different types of aquaculture systems and their management.
3. To recognize the importance of aquaculture and list the commercially important aquaculture species.
4. To develop knowledge about the different culture methods and fish breeding techniques in aquaculture.
5. To encourage students in taking up aquaculture as a profession and to pursue further research

COURSE OUTLINE:

UNIT- I

Definition, scope and importance.Marine and Inland fishery resources in India, their conservation and management.Abiotic and biotic factors of water necessary for fish life.Ecological characteristics of lake, rivers and reservoirs of India. **(15Hrs)**

UNIT- II

Fresh water fish farm- Selection of site, construction of fish farm and soil chemistry.Designing, layout and construction of different types of fish ponds.Settingand management of fresh water aquarium.Water pollution and its effects on fisheries.Common fish diseases and their control. **(15Hrs)**

UNIT- III

Fish culture - Mono, Poly, Mixed and Composite. Fresh water prawn culture and its prospects in India. Culture of Mussels, clams, oysters and pearl culture, Sewage fed fish culture, paddy cum fish culture and Sea weed culture. Different types of crafts and gears used in aquaculture,**(15Hrs)**

UNIT- IV

Fish breeding - Natural conditions - Bundh breeding, Artificial Breeding - Hypophysation and Stripping.Eyestalk ablation in shrimp. Larval nutrition - Importance of live feed and formulated feed. Common weeds of fish ponds and methods of their eradication.Bioencapsulation – Methods of bioecapsulation, advantages and disadvantages. Application of nanotechnology in diet delivery.Role of probiotics in aquaculture system.Packing and transportation of live fish. **(15Hrs)**

UNIT- V

Advanced farming practices and Aqua Entrepreneurship -Recirculating Aquaculture System (RAS), Aquaphonics, Biofloc techniques and organic farming.Extension techniques for aquaculture, Economics and marketing aspects of aquaculture. Preservationand processing of fish.By products of fish industry and their utility.Biochemical composition and nutritional value of fish.Aquaculture Institutions – CMFRI, CIBA, CIFT, CIFA & CIFE.

(15Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	General &AppliedIchthyology	S. K. Guptaand P.C. Gupta	S. Chand	2014
2..	Fishery Science and Indian Fisheries	C.B.L. Srivastava and SushmaSrivastava	KitabMahal	2006

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	An Introduction To Fish Biology And Fisheries	Dr. S. S. Khanna& Dr. Neerja	Kapoor, Surjeet Publications	2019
2	Hand Book Of Fisheries And Aquaculture	Dr. S. Ayyappan	Indian Council Of Agricultural Research, New Delhi	2017
3	Aquaculture And Fish Farming	Brendan Marshal	Larsen And Keller	2017
4	Aquaculture Principles and Practices	TVR. Pillay and M.N. Kutty	Wiley India Pvt Ltd	2011
5	A Textbook of Fish Biology And Fisheries	Khanna S S, H R Singh	Narendra Publish.House-Delhi	2009

JOURNALS:

Aquaculture- Elsevier

Journal of Applied Aquaculture

E-LEARNING RESOURCES:

http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/3072/art06.pdf?sequence=1

http://fishcount.org.uk/farmed-fish-welfare/development-of-intensive-fish-farming

http://www.fao.org/fileadmin/templates/SEC/docs/Fishery/cage/3DAAPM_en.pdf

https://www.tandfonline.com/doi/abs/10.1080/10641262.2010.535046

http://animal-world.com/encyclo/fresh/information/Diseases.htm

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO1	To explain the biology of fishes and Aquarium fish keeping technology

CO2	To develop knowledge onthe fish farm and their maintenance. Aspirants can go for entrepreneurship in their own fisheries related business.
CO3	To apply the knowledge about different culture methods are used in aquaculture
CO4	To gain knowledge on fish and shrimp breeding techniques and larval culture.
CO5	To gain knowledge on recent trends in aquaculture.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	3	3	3
CO2	2	2	3	3	3	3
CO3	2	2	3	3	3	3
CO4	2	2	2	3	3	3
CO5	2	3	2	2	3	3
AVERAGE	**2.2**	**2.4**	**2.6**	**2.8**	**3**	**3**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	**Section**	**Word Limit**	**Marks**	**Total**
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER IV

PRACTICAL- III ANIMAL PHYSIOLOGY, BIOCHEMISTRY, IMMUNOLOGY AND RECOMBINANT DNA TECHNOLOGY

TOTAL HOURS: 120 **COURSE CODE: 5P21/4C/MP3**

CREDITS : 4 **L-T-P: 0-0-8**

COURSE OBJECTIVES:

1. To assess the RQ & Salt lost & Salt gain in fishes, to determine the amino acids in the tissues, to estimate the blood glucose level and to appraise the principles and applications of instruments in physiology.
2. To explain the method of hematology in depth by estimating the amount of various components in blood and their significant level and exhibit clear and concise scientific data in the field of biochemistry.
3. Distinguish the lymphoid organs and to enumerate the lymphocytes in the blood samples.
4. Ability to perform routine blood analysis to develop analytical and critical thinking skills in biological phenomena through scientific method.
5. To impart knowledge in various techniques in the field of biotechnology.

COURSE OUTLINE:
ANIMAL PHYSIOLOGY

1. Estimation of RQ in fish with reference to temperature
2. Oxygen consumption in terrestrial animal (cockroach)
3. Salt loss and Salt gain in Fish
4. Determination of amino acids in the tissues (paper chromatography)
5. Estimation of Blood glucose level
6. Principles and applications of the following instruments: Kymograph, spectrophotometer, Sphygmomanometer, Electrophoretic unit

BIOCHEMISTRY

1. Blood: Clotting time, bleeding time.
2. Estimation of hemoglobin

3. Erythrocyte Sedimentation Rate (ESR)-Chick Blood
4. Estimation of Blood Urea (DAM Method)
5. Estimation of Blood creatinine (Jaffe's method)
6. Estimation of Blood Cholesterol (Zaks method)

IMMUNOLOGY

1. Histology of Lymphoid organs- Thymus, spleen, Bone marrow, Lymph nodes
2. Isolation of lymphocytes and enumeration – DC
3. Immunodiffusion
4. Determination of antigenic determinants.

BIOTECHNOLOGY

Demonstration:

a. PCR
b. Agarose gel electrophoresis of DNA

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1	Text book of Practical Physiology	G.K. Pal Pravathi pal	OrietBlackswan	2006
2	Text book of practical Biochemistry	Dr. Rashmi A. Joshi and Dr. ManjuSaraswat	B. Jain Publishers	2002

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Practical Biochemistry	GeethaDamodaran. K	Jaypee Brothers, Medical Publishers. Pvt. Limited	2016
2.	Principles and Techniques of Practical Biochemistry	Keith Wilson and John Walker	Cambridge University Press	2002
3.	Practical Immunology	Frank C. Hay Olwyn M.R. Westwood	Blackwell Publishing Company	2002
4.	An Introduction to Practical Biotechnology	Harisha. S.	Laxmi Publications	2006
5.	Practical Biotechnology : Methods and Protocols	S. Janarthanam	University press	2007

E-LEARNING RESOURCES:

https://www.cell.com/immunology/pdf/0167-5699(84)90014-8.pdf

https://www.studocu.com/en-au/document/rmit/immunology/practical/practical-immunology-practicals/312007/view

https://www.kopykitab.com/An-Introduction-to-Practical-Biotechnology-ebook

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2384617/

http://site.iugaza.edu.ps/mwhindi/files

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	To deduce the RQ salt content,aminoacids in the tissue & the glucose in the experimental animal.
CO 2	Exhibit and knowledge in the field of immunology and biotechnology.
CO 3	Deduce the number of lymphocytes & identify the antigen determinants.
CO 4	Will be able to demonstrate agarose gel electrophoresis of DNA.
CO 5	Provide hands on training to use various bio instruments in the research laboratoy

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	3
CO2	3	2	2	2	1	2
CO3	1	3	3	2	2	1
CO4	2	2	3	3	3	3
CO5	3	2	3	2	2	2
Average	2.2	2.2	2.8	2.4	2	2.2

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY

Demonstration, Group discussion of result and inference

SEMESTER IV

PRACTICALIV - DEVELOPMENTAL BIOLOGY, ENVIRONMENTAL BIOLOGY AND AQUACULTURE

TOTAL HOURS: 120 COURSE CODE: 5P21/4C/MP4
CREDITS : 4 L-T-P: 0-0-8

COURSE OBJECTIVES:

1. To acquire knowledge on the developmental stages of chick embryo and metamorphic stages of frog can be observed.
2. To associate the sandy shore, rocky shore and muddy shore fauna with their eco-system.
3. To determine the hydro biological features of the water samples.
4. To identify, observe and study of commercially important fishes, prawns, crafts and gears.
5. To impart knowledge in practical skills for current technology utilization

COURSE OUTLINE:

DEVELOPMENTALBIOLOGY

1. Histological studies in a mammal: (i) T.S of mammalian Ovary (ii) T.S of mammalian Testes
2. Development in chick embryo-Observation of live chick embryo using vital stain
3. Developmental stages of Frog metamorphosis.
4. Induced ovulation in fish using hormone (Demonstration)
5. Observation of maturity stages of ovary and testes
6. Determination of gonadosomatic index and fecundity

ENVIRONMENTALBIOLOGY

1. Identification of

i.Marine plankton

2. Study of
   i.Rocky shore fauna
   ii.Sandy shore fauna
   iii.Muddy shore fauna
3. Determination of hydro biological features of different samples (tap water, sea water, brackish water and polluted water)
   i. pH
   ii.Salinity
   iii. Free carbondioxide
   iv.Dissolved oxygen
   v.Calcium
4. Animal association- Parasitism, Mutualism and Commensalism
5. Study of fauna in their natural habitats by visiting places of zoological interest.

AQUACULTURE

i. Fish morphology-Morphometeric characters –Head structures.
ii. Types of scales in fishes – Placoid, Cycloid and Ctenoid scales.
iii. Identification of Marine fishes (5 nos.), Freshwater fishes (2 nos.), Estuarine fish (1 no.) up to species level using Day's Volumes.
iv. Commercially important invertebrates: Crab,Lobsters, Pearl Oyster, Edible Oyster, Mytilus, Sepia and Loligo- their importance.
v. Observation of Gears and Crafts – Cast net, Drag net, Bag net and Catamaran.
vi. Identification of cultivable Prawns – *Penaeusindicus, Penaeus monodon, Macrobrachiumrosenbergii*
vii. Observation of fish farm implements- Sacchi's disc, pH meter, Aerator and Plankton net.
viii. Identification of 5 common ornamental fishes – *Carassiusauratus, Trichogasterlalius, Pterophyllumscalare, Poeciliareticulata, Poeciliasphenops.*
ix. Visit to hatchery, Fish landing and Fishery institutes.

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Water Quality Indices	S. A Abbasi and TasneemAbbai	Elsevier Publishers	2002
2.	A Manual Of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1	M.M. Trigunayat	Scientific Publishers India	2019

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	A Practical Guid to Developmental Biology	Gibbs	Ane/Oxford Exclusive	2006
2.	Water analysis	W. Fresenius, K.E. Quentin & W. Schneider	Springer	2011
3.	Classification and Identification of Fresh water Fishes	C.J. Hiware, R.T. Powar, J.M. Gaikward& S.R. Sonawane	Daya Publishing House	2015
4.	A book of mammalian histology	Dr. Kishore R. Pawar, Dr. Ashok E. Desai	NiraliPrakashan	2018
5.	Hand Book of Water Analysis	Leo M.L.Nollet and Leen S.P. De Gelder	CRC Press	2013

JOURNALS:

An International Journal of Aquaculture

Indian Journal of Fisheries

E-LEARNING RESOURCES:

https://ocw.mit.edu/courses/earth-atmospheric-and-planetary-sciences/12-097-chemical-investigations-of-boston-harbor-january-iap-2006/labs/dissolved_oxygen.pdf

http://www.fisheriesjournal.com/archives/2017/vol5issue6/PartC/5-6-17-154.pdf

http://cec.nic.in/wpresources/module/Zoology/Paper-11/13/Script%20Original%20PDF/Original%20Document/file1.pdf

https://www.sciencedirect.com/topics/immunology-and-microbiology/vital-stain

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwi70anaso7kAhXELY8KHWGzA60QFjACegQIARAC&url=http%3A%2F%2Fwww.vliz.be%2Fimisdocs%2Fpublications%2Focrd%2F2558.pdf&usg=AOvVaw0Mjs2VV6Um7vM0SIXbBfs2

COURSE OUTCOMES:

Students will be able to

CO NUMBER	CO STATEMENT
CO 1	Identify the different stages of frog metamorphosis and developmental stages of chick embryo.
CO 2	Relate gonodosomatic index and fecundity
CO 3	Inculcate current knowledge in assessment of water samples (pH, salinity, free carbon dioxide, dissolved oxygen and calcium, pH and oxygen), able to differentiate marine and freshwater planktons, will also develop knowledge about sandy, muddy and rocky shore fauna.
CO 4	Encounter and overcome the issues in aqua farming.
CO 5	Judge the difference between fresh and marine water fishes and also gain clear knowledge about fish morphometry.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	2	2
CO2	3	3	3	2	2	2
CO3	3	2	2	3	3	3
CO4	3	3	3	3	3	3
CO5	3	2	3	3	2	2
AVERAGE	**3**	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Demonstration , E-content, Videos and Field Visit.

SEMESTER – III
SOFT SKILL III - DAIRY FARMING

TEACHING HOURS: 30 **PAPER CODE: 5P21/3S/DFG**
CREDITS: 2 **L T P: 2-0-0**

COURSE OBJECTIVES :

1. Tocompileandcharacterizedifferentbreedsofdairyanimalsandacquiretechnicalskillsindairybreedingandfeedformulation.
2. Todemonstratefoundationonprocessingofmilkandelucidatemilkadulterantsandtheirdetection..
3. Togainknowledgeonthecausativeagentsandpreventivemethodsinlive-stockdiseases
4. Tointegratefarmmanagementandmarketingindairytechnologyandinculcateentrepreneurialskillsinlearningcommunities.
5. Toenhancecollaborativelearningthroughprojects,seminars,presentations,groupdiscussions,assignments.

COURSEOUTLINE:

Unit-I

Dairy Breeds and Breeding Technology Distinguishing characteristics of Indian and exoticbreeds of dairy animals and their performance.Systems of breeding- hybrid vigor,grading,purebreedingmeritsanddemeritsofinbreedingandoutbreeding.Techniquesofproducing quality milk- artificial insemination,MOET – semen collection storage andinsemination techniques.Feeding and Nutrition - cattle pellet feed formulation , feedadditivesandsilagepreparation.

(10Hrs)

UnitII

ProcessingofmilkandDetectionofmilkadulterants

Gross Composition of milk and its nutritive value . Microbiology of milk.Processing ofmilk-Pasteurization,clarification,separation,bactofugation,homogenization,sterilizationand ultra hightemperature.Non edible milk adulterants-Urea,Formalin,Borax and boricacid,Benzoicandsalicylicacid,HydrogenPeroxide,Ammoniumsulphate,Detergents,PulverisedsoapandNitrates–RapidQualitativedetectionofmilkadulterants..Spoilageofmilk **(10Hrs)**

UnitIII

Livestockdiseases, FarmManagementandMarketing.

ViraldiseasesRinderpest,FootandMouthdiseaseandCowpox.Bacterial diseases-Mastitis, Anthrax, Tuberculosis Hemorrhagic septicemia Brucellosis-FungaldiseasesProtozoanandHelminthicdiseases.Dairy farm layout and design. Preparation of Dahi, butter, ghee and traditional milkproducts.Application of PFA,AGMARK,BIS and CODEX related to quality of milk and milkproducts.RoleofCo-operativesocietiesandSmallandmediumenterprises(SMEs)inmilkproductionandmarketing.

(10Hrs)

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Handbook on Dairy farm management including Fodder Management	Rangasamyseerangan & Raja Sengodan	LAP-Lambert Academic Publishing	2015
2.	Collection of materials for diagnosis of livestock diseases	SelvarajuGanapathy	Scholars Press	2014

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication

1.	Principles of Dairy Science	G.H Schmidt &T.D Van Vleck	SurgetPvt,Ltd	1982
2.	Farm Animal Management	N.S.R Sasting&Ck Thomas	Vikas Publishing house Pvt Ltd	1976
3.	Animal reproduction and Artificial insemination	Dr.A.K.Sachetic	NCERT	1989
4	Emerging and Re-emerging Infectious Diseases of livestock	JagadeshBayry	Springer	2017
5	Design,development and testing of milk pasteurization system	VinodArkari Vivekkanawade KrantidipPawar	LAP-Lampert Academic Publishing	2015

JOURNALS:

International Journal of Dairy Technology

Journal of Dairy science

E-LEARNING RESOURCES:

https://www.growlagrovel.com

https://odisharet.com>dairy –farm-project

https://www.dairycouncil.co.uk>pasteurisation

http://dairyprocessinghandbook.com

https://www.galvmed.org>livestock diseases

COURSE OUTCOMES:

CO	**CO STATEMENT**
CO1	To characterize different breeds of dairy animals anddemonstratebreedingtechniquesandfeedformulationskillindairyfarming.

CO2	Listdowndifferentmilkprocessingmethodsandillustratemanufacturing of milk products. To critically analyze milkadulterantsandtheirrapiddetection.
CO3	Tabulatethedifferentcausativeagentsofcattle diseaseswiththeirsymptomsandpreventivemeasures. Topreparethestudentsontheirentrepreneurialskillsinmilkproductionand marketing.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	2	3	3
CO2	3	3	3	3	2	2
CO3	3	3	3	3	3	3
AVERAGE	**3**	**3**	**3**	**2.6**	**2.6**	**2.6**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X6 marks**	**500**	**30**	**100**
K4,K5	**B-1 X 20 marks**	**1500**	**20**	

SEMESTER- IV

SOFT SKILL IV –POULTRY FARMING

TOTAL HOURS: 30 **COURSE CODE:**

5P21/4S/PFMCREDITS :2 **L-T-P: 2-0-0**

COURSE OBJECTIVES:

1. Todiscusspoultryfarmingwiththeirscopesandimportance.
2. TogainknowledgeondifferentDesibreedsoffowlandtheirbreedingtechniques.
3. Todeveloptheskillonpoultryfarmmanagementandrearingtechniques.
4. Toacquireskillinpoultryfeedformulationandcombatpoultrydiseases.
5. Toinculcateentrepreneurialskillinpoultryfarmingandeducateeconomicsofpoultryproductsmaking.

COURSEOUTLINE:

Unit-I

Indigenous - Desi breeds of chickenGiriraja,Vanaraja,Gramapriya,NandanamChicken-1,NandaChicken-2, Gramshree,Gramalakshmi, Namakkal Desi Chicken CARI Nirbheek (Aseel Cross) Hitcari(nakedneckcross)Swarnadhara,Girirani,Krishbro,KalingaBrown.Maturityandegglayingcapacity - different types of egg (black fowl) - Nutritive value of eggs -Genetics of fowl-Inheritanceofqualitativeandquantitativetraitscharacters-listofautosomalandsexlinked characters.Breedingmethods-1,2,3,4LinecrossbreedingandMating--Penmating,FlockmatingandStudmating.

(10Hrs)

UnitII

Poultry industry in India a survey- Choosing commercial layers and broilers- Sexing

gradingand culling.Poultry housing- Deep Litter system- Cage rearing poultry methods.Practicalaspects of chick rearing- management of Growers- management of Layers and Broilers-Lighting,summerandwintermanagement.Poultrywastemanagement.Debunking. **(10Hrs)**

UnitIII

Poultrynutrition,energyanddiseases.Proteinandaminoacids-Vitamins-Essentialorganicelements-Debeaking.Nonnutritivefeedadditives-Antioxidants,Antibiotics ,Coccidiostats,Enzymes,Hormones,Pelletbinders,Immunostimulantsetc.Feedstuffsforpoultry- feed formulation. Diseases- virus, bacteria, fungi and parasites.vaccination program-PoultryEntrepreneurshipandPoultryproductsmaking.**(10Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Poultry Science, 3rd edition	Ensminger M.E	. CBS Publishers & Distributors	2015
2	Textbook of Poultry Science	P.V. Sreenivasaiah,	WRITE AND PRINT PUBLICATIONS	2015

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Poultry Science Practice: Textbook ; 1st edition	NilotpalGhosh	CBS Publishers & Distributors	2015
2.	Handbook of Poultry Production and Management	Jadhav,	Jaypee Brothers Medical Publishers Private Limited	2010
3.	Poultry Diseases, Diagnosis and Treatment	H.V. S. Chauhan,	New Age International Private Limited	2018
4	Modern Poultry Farming	Louis M Hurd,	IBDCHB	2003

5	Hand Book of Poultry Farming And Feed Formulations	Eiri Board ,	Engineers India Research Institute	2008

JOURNALS:

International Journal of Poultry Science

The Journal of Poultry Science

E-LEARNING RESOURCES:

http://www.agritech.tnau.ac.in/expert_system/poultry/strains.html

http://www.poultryhub.org/production/husbandry-management/poultry-behaviour/

http://agritech.tnau.ac.in/animal_husbandry/ani_chik_grower&layer%20mgt.html

https://www.bioscience.com.pk/topics/zoology/item/636-poultry-farming-layers-and-broilers

https://www.nap.edu/read/2114/chapter/3#4

COURSE OUTCOMES:

CO NUMBER	**CO STATEMENT**
CO 1	Tolistdifferentdesibreedsoffowlsandillustratetheirbreedingtechniques.
CO 2	To outline the modern poultry farming technology
CO 3	Todemonstrateskillsinpoultryfarmmanagement ,rearingtechniquesandmanagewasteinpoultryfarming
CO 4	Toformulateandpreparepoultryfeedswiththeirnutritionalvalues. Toapplytheentrepreneurialskillonpoultryfarming.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	3	3	3
CO2	2	2	3	3	3	3
CO3	2	2	3	3	3	3
CO4	2	2	2	3	3	3
AVERAGE	**2.2**	**2.2**	**2.8**	**3**	**3**	**3**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	A-5X6 marks	500	30	100
K4,K5	B-1 X 20 marks	1500	20	

SEMESTER – II
MATERNITY AND CHILD CARE
ELECTIVE (OFFERED TO OTHER DEPARTMENT STUDENTS)

TEACHING HOURS: 60 PAPER CODE: 5P21/2E/MCC
CREDITS: 3 L T P: 2-2- 0

COURSE OBJECTIVES:

1. To enable the students to relate & distinguish the anatomy and physiology of human reproductive system.
2. To enable the students to explain the process of gametogenesis and role of hormone in gametogenesis.
3. To draw and explain the process of fertilization in Man
4. To interpret the phases of maternity with reference to infertility causes and birth control techniques.
5. To educate the students on prenatal and post-natal care with special reference to blood group and immunization.

COURSE OUTLINE:

Unit I:

Structure and functions of mammalian Reproductive organs – Physio-anatomy of male reproductive organ & Hormonal regulation of male reproduction.Physio-anatomy of female reproductive organ & Hormonal regulation of female reproduction.

(12 Hrs)

Unit II:

Formation of gametes – spermatogenesis: formation of spermatid, spermiogenesis& significance of spermatogenesis, Structure of spermatozoan. Oogenesis – Maturation of ovum, structure of human ovum – Ovulation – Hormonal control of ovulation.Sexual cycles in mammalian females: Oestrous cycle & menstrual cycle.

Mammary gland - Structure, function and regulation. Hormonal changes in mammary gland during menstrual cycle – puberty – menarche – menopause.

(12 Hrs)

Unit III:

Fertilization: Mechanism & significance of fertilization, Monospermy and Polyspermy in fertilization. Implantation, Fetal growth & development, premature or abnormal birth, still birth, congenital anomalies, etc., Twins: Identical and non-identical twins, siamese twins

(12 Hrs)

Unit IV:

Pregnancy – Maternal physiologic changes in pregnancy –Test for pregnancy. Birth control: reasons & measures for birth control - Contraception: contraceptive methods & Abortion. Artificial insemination in man – Test tube baby – amniocentesis. Infertility: Reasons, tests & remedial measures for Male and Female infertility.

(12 Hrs)

Unit V:

Immunoprophylaxis: Immunization, general principles of immunization, Immunization methods: active & passive (artificial & natural), Immunization schedule for children, Immunization agents: Vaccines, common vaccines used in Immunoprophylaxis. Prenatal – postnatal care – ABO Blood group, Rh factor Erythroblastosisfoetalis.

(12 Hrs)

RECOMMENDED TEXTBOOKS:

S. No	**Title of the Book**	**Authors**	**Publishers**	**Year of Publication**
1	Chordate Embryology	Verma P S, Agarwal & V.K.	S Chand	**2010**
2	Developmental Biology	Dr. K.V. Sastry, Dr. Vineeta Shukla	Rastogi Publications	2018

REFERENCE BOOKS:

S. No	**Title of the Book**	**Authors**	**Publishers**	**Year of Publication**

1	Human Reproductive Biology	Richard E. Jones, Kristin H Lopez	Academic Press	2013
2	A Text Book of Animal Physiology & Biochemistry	VasantikaKashyap	Kedarnath& ram nath publisher	2020
3	Immunology of Pregnancy	Gérard Chaouat, Olivier Sandra, & Nathalie Lédée	Bentham books	2013
4	Immunization in pregnancy	Dr. Indira palo	Ahyyan Books	2021
5	Immunology	N. Arumugam, Dulsy Fatima,	Saras Publication	2015

JOURNALS:

International Journal of Pregnancy and Child birth

Journal of Human Reproductive Sciences

E-LEARNING RESOURCES:

https://my.clevelandclinic.org/health/articles/9118-female-reproductive-system
https://ocw.mit.edu/courses/health-sciences-and-technology/hst-071-human-reproductive-biology-fall-2005/lecture-notes/
https://www.msdmanuals.com/en-in/home/women-s-health-issues/biology-of-the-female-reproductive-system/menstrual-cycle
https://www.visiblebody.com/learn/reproductive/reproductive-process
https://opentextbc.ca/biology/chapter/24-5-human-pregnancy-and-birth/

COURSE OUTCOMES:

CO NUMBER	CO STATEMENT
CO 1	Will be able to draw and explain human reproductive system and influence of hormone in maturity.
CO 2	Will be able to give a diagrammatic representation of steps involved in human gametogenesis.
CO 3	Will be able to explain the process of fertilization in man.
CO 4	Will be able to explain maternal changes and parturition and also list down the reasons for infertility and their treatment.
CO 5	Will be able to list out the prenatal and postnatal care and tabulate the immunization schedule.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	3
CO2	3	3	2	2	2	3
CO3	3	3	3	3	3	3
CO4	3	3	3	2	3	3
CO5	3	3	3	2	2	3
AVERAGE	**3**	**3**	**2.8**	**2.4**	**2.6**	**3**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, Smart Class, OHP, e-content, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4, K5	**B-3x20 marks**	**1500**	**60**	

SEMESTER III

AQUARIUM FISHES

ELECTIVE (OFFERED TO OTHER DEPARTMENT STUDENTS)

TOTAL HOURS: 60 **COURSE CODE: 5P21/3E/AQF**

CREDITS :3 **L-T-P: 3-1-0**

COURSE OBJECTIVES:

1. To introduce the nature and scope of aquarium management and ornamental fish culture.
2. To create basic understanding on the nutritional requirements of fish and different feed management.
3. To understand the setting up of an aquarium with appropriate fish and to learn effective water quality management practices.
4. To gain adequate technological knowledge in breeding, seed production and health management of ornamental species.
5. To create awareness among the women on entrepreneurial skill in fisheries sector.

COURSE OUTLINE:

Unit I:

Introduction to ornamental fishes - Importance and scope of ornamental fish culture, present global and national scenario. Taxonomy, biology and sexual dimorphism of commercially

important fresh water and marine species- - *Poeciliareticulata*(Guppy), *Xiphophorushelleri* (Sword tail), *Carassiusauratus*(Gold fish), *Betta splendens*(Siamese fighting fish), *Scatophagusargus*(Spotted scat), *Chaetodonvagabundus*(Vagabond butterfly fish), *Pteroisvolitans*(Red lion fish). **(12 Hrs)**

Unit II:

Food and Feeding Management - Live feed organisms (*Algae, Cyclops, Rotifer, Artemia, Daphnia and Tubifex.)*. Formulation and preparation of artificial feeds.Colour enhancement through pigmented feed. **(12 Hrs)**

Unit III:

Aquarium Keeping and Water quality Management -Construction and maintenance of aquariumgarden tank., Material required for setting up an aquarium, Aquarium accessories (Aerators, Heaters, Filters, Lighting, Thermostatic, Décorates and Food dispensers), Selection of stone and gravel, Planting of aquarium, Tank conditioning and stocking and acclimatization. Water quality management in aquarium. **(12 Hrs)**

Unit IV:

Breeding techniques and Health assessment: Live bearers and Egg layers. Development of brood stocks, Selection of brood fishes, Induced breeding, Larval rearing and transportation. Common diseases of aquarium fishes and their control – Microbial, Bacterial, Viral, Fungal and Parasitic diseases (external & internal). **(12 Hrs)**

Unit V:

Prospects of ornamental fishes: Export and industrial importance - Regulations in ornamental fish trade in India. Funding opportunities and Grants- Role of women in ornamental fish culture.**(12 Hrs)**

RECOMMENDED TEXTBOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Ornamental Fish Culture and Aquarium Management	Anshuman D. Dholakia	Astral International Publisher	2016

2.	A Textbook of Pisciculture and Aquarium Keeping	H.S. Jagtap, S.N. Mukherjee& V.K. Garad	Astral International Publisher	2009

REFERENCE BOOKS:

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Marine Aquarium keeping	Stephen Spotte	John Wiley & Sons	1973
2.	Diseases of aquarium fishes	Robert Goldstein	T.F.H. Publication	1971
3.	A guide to fresh water Aquarium fishes	Harvey Jack Hims. Georg, F	Hamylnn publications.	1973
4.	Keeping and Breeding Aquarium Fishes	C.W. Emmens	Academic Press Inc., Publishers	1953
5.	Aquarium Fish Breeding	Jay F. Hemdal	Barron's Publisher	2003

JOURNALS:

Aquarium Sciences and Conservation(Springer)

Indian Journal of Fisheries

E-LEARNING RESOURCES:

http://cifa.nic.in/sites/default/files/ORNAMENTAL%20FISH%20CULTURE_0.pdf

http://eprints.cmfri.org.in/8416/1/Lipton.pdf

https://mpeda.gov.in/MPEDA/production_ornamental_fish_important_species.php#\

https://www.sahapedia.org/status-of-women-ornamental-fish-farming

http://www.fisheriesjournal.com/vol1issue4/pdf/71.1.pdf

COURSE OUTCOMES:

Students will be able to

CO NUMBER	CO STATEMENT
CO1	Identify and utilise the potential resources available in India

CO2	Get vast knowledge on the nutritional requirements and various types of feed like live food organisms and pellet feed.
CO3	Learn the basic aspects of successful aquarium setting and maintain their own aquarium tank.
CO4	Acquire holistic knowledge on fish breeding, pathogens and their control measures.
CO5	Appreciate the future prospects of ornamental fisheries with relevant knowledge on the economics of fresh and marine water fisheries in the fishery industry.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	2	3	2	2
CO2	3	3	3	3	3	3
CO3	3	2	3	2	2	3
CO4	3	3	3	3	3	3
CO5	2	3	2	3	3	3
AVERAGE	**2.6**	**2.4**	**2.6**	**2.8**	**2.6**	**2.8**

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Smart Class, e-content, Group Discussion, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4,K5	**B-3x20 marks**	**1500**	**60**	

III SEMESTER

SELF STUDY PAPER

RESEARCH METHODOLOGY

Credits : 2

Course Objectives

1. To impart knowledge on scientific methods in basic research and its methodologies.
2. To develop the right approach on research problems and their predictions.
3. To make the student to understand the importance of systematic protocol in research
4. To motivate the student to have good communication and presentation skill in writing research papers.
5. To acquaint the students with basics of intellectual property rights with special reference to Indian laws & practices.

Course Outline:

UNIT-I

Introduction – Objectives of Research - Types of Research, Application Oriented , Objective Oriented, Conceptual , Applied, Fundamental, Quantitative andQualitative - Significance of Research - Research process – Problems encountered in research. Research Formulation- Identification and formulating of research problems – Techniques involved

UNIT-II

Research Designs- Exploratory, Descriptive and Causal research design - Research hypothesis - Testing and errors in hypothesis - Research plan – Types of Research Plan. Literature review - Collection and importance - Stages of literature search - Web source- Collection and classification of data

UNIT-III

Information Science- Sources of Information –Scientific reports – Research paper - Review articles- Journal Article.Library, books, journals, periodicals, reference sources, Abstracting and indexing sources, Reviews, Treatise, Monographs, Patents, Internet -Search engines and software, Online libraries, e-Books, e-Encyclopedia, TED Talk, InstitutionalWebsites.

UNIT-IV

Research report writing - Thesis writing -structure and layout - Tabulation – Graphical presentation – Diagrammatic Presentation of Data – Bibliography – Footnotes- Plagiarism.Project proposal writing - Presentation techniques - Oral presentation ,Poster presentation,Conference , Seminar, Workshop.

UNIT-V

Intellectual Property Rights - Copy right- Patents - Trademarks - Safety and precaution - ISO standards for safety - Lab protocols - Lab animal use, care and welfare, Extension - Lab to Field - Life Science Projects and Funding Agencies- Bioethics – Ethical Committees and Constitution.

Reference Books

S. No	Title of the Book	Authors	Publishers	Year of Publication

1.	Law relating to intellectual property rights	AnithaGoel	Lexis Nexis-Butterworths Wadhwa	2010
2.	Research Methodology for Scientific Research	K. Prathapan	Wiley India Pvt. Ltd.	2021
3.	Research Methodology The Aims, Practices and Ethics of Science	Pruzan, Peter	Springer International Publishing	2016
4.	Introducing Research Methodology: A Beginner's Guide to Doing a Research Project	Uwe Flick	Sage Publications India	2017
5.	An Introduction to Scientific Research	Chap T.Le	Dover Publications	2003

E- Learning Resources:

https://research-methodology.net

https://cirt.gcu.edu

https://www.researchgate.net

https://www.sciencedirect.com

https://socialresearchmethods.net

http://serb.gov.in https://www.aamc.org

http://www.ipindia.nic.in

Course Outcomes

Students will be able to

CO No.	CO Statement	Knowledge Level
CO 1	Identify, explain and apply the basic concepts of research in research process.	K1
CO 2	Define and formulate research problems.	K2
CO 3	Exhibit a successful plan and execution of research designs.	K3
CO 4	Write research proposal in required format with necessary details. And also be motivated to attend seminars and conferences to gain knowledge on the related field.	K4
CO 5	Apply intellectual property law principles in research problems and analyze its social impact	K2

MAPPING – COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	1	1	1	1
CO 2	2	2	3	2	1	2
CO 3	2	2	2	2	1	2
CO 4	3	2	1	3	2	2
CO 5	2	2	1	1	1	2
Average	**2.2**	**2**	**1.6**	**1.8**	**1.2**	**1.8**

Mapping of CO with PSO

CO/PO	PSO 1	PSO 2	PSO 3
CO 1	1	1	2
CO 2	2	2	3
CO 3	2	2	3
CO 4	2	1	3
CO 5	1	1	3
Average	**1.6**	**1.4**	**2.8**

***Mapping Levels: 1 – Slight (Low) 2- Moderate (Medium) 3- Substantial (High)**

Teaching Methodology

Lecture by chalk and talk, Smart Class, e-content, Group Discussion, Assignment, Quiz and Seminar.

QUESTION PAPER PATTERN-PG*

Knowledge Level	Section	Word Limit	Marks	Total
K 3	**A-5X8 marks**	**500**	**40**	**100**
K4, K5	**B-3x20 marks**	**1500**	**60**	