FATIMA COLLEGE (AUTONOMOUS)

Re-Accredited with "A++" Grade by NAAC (Cycle IV)
Maryland, Madurai- 625 018, Tamil Nadu, India

NAME OF THE DEPARTMENT: ZOOLOGY

NAME OF THE PROGRAMME : M. Sc

PROGRAMME CODE : PSZO

ACADEMIC YEAR :2023 - 2024

VISION OF THE DEPARTMENT

Women Empowerment through Biological Education for the Betterment of Environment and Mankind

MISSION OF THE DEPARTMENT

- To ensure quality education offering skill-based program
- To render entrepreneurial training to make students employable
- To create awareness on the conservation of Biodiversity
- To give ultimate insight into the correlation of various branches of biology that has overwhelming applications
- To facilitate Higher education & research (for the advanced learners)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1	Our graduates will be academic, digital and information literates; creative, inquisitive, innovative and committed researchers who would be desirous for the "more" in all aspects
PEO 2	They will be efficient individual and team performers who would deliver excellent professional service exhibiting progress, flexibility, transparency, accountability and in taking up initiatives in their professional work
PEO 3	The graduates will be effective managers of all sorts of real – life and professional circumstances, making ethical decisions, pursuing excellence within the time framework and demonstrating apt leadership skills

PEO 4	They will engage locally and globally evincing social and environmental stewardship demonstrating civic responsibilities and employing right skills at the right moment.

GRADUATE ATTRIBUTES (GA)

Fatima College empowers her women graduates holistically. A Fatimite achieves all-round empowerment by acquiring Social, Professional and Ethical competencies. A graduate would sustain and nurture the following attributes:

I. SOCIAL COMPETENCE	
GA 1	Deep disciplinary expertise with a wide range of academic and digital literacy
GA 2	Hone creativity, passion for innovation and aspire excellence
GA 3	Enthusiasm towards emancipation and empowerment of humanity
GA 4	Potentials of being independent
GA 5	Intellectual competence and inquisitiveness with problem solving abilities befitting the field of research
GA 6	Effectiveness in different forms of communications to be employed in personal and professional environments through varied platforms
GA 7	Communicative competence with civic, professional and cyber dignity and decorum
GA 8	Integrity respecting the diversity and pluralism in societies, cultures and religions
GA 9	All – inclusive skill - sets to interpret, analyse and solve social and environmental issues in diverse environments

GA 10	Self-awareness that would enable them to recognise their uniqueness through continuous self-assessment in order to face and make changes building their strengths and improving on their weaknesses
GA 11	Finesse to co-operate exhibiting team-spirit while working in groups to achieve goals
GA 12	Dexterity in self-management to control their selves in attaining the kind of life that they dream for
GA 13	Resilience to rise up instantly from their intimidating setbacks
GA 14	Virtuosity to use their personal and intellectual autonomy in being life-long learners
GA 15	Digital learning and research attributes
GA 16	Cyber security competence reflecting compassion, care and concern towards the marginalised
GA 17	Rectitude to use digital technology reflecting civic and social responsibilities in local, national and global scenario
II. PROFESSIONAL COMPETENCE	
GA 18	Optimism, flexibility and diligence that would make them professionally competent
GA 19	Prowess to be successful entrepreneurs and employees of trans-national societies
GA 20	Excellence in Local and Global Job Markets
GA 21	Effectiveness in Time Management
GA 22	Efficiency in taking up Initiatives
GA 23	Eagerness to deliver excellent service
GA 24	Managerial Skills to Identify, Commend and tap Potentials
III. ETHICAL COMPETENCE	

GA 25	Integrity and discipline in bringing stability leading a systematic life promoting good human behaviour to build better society
GA 26	Honesty in words and deeds
GA 27	Transparency revealing one's own character as well as self-esteem to lead a genuine and authentic life
GA 28	Social and Environmental Stewardship
GA 29	Readiness to make ethical decisions consistently from the galore of conflicting choices paying heed to their conscience
GA 30	Right life skills at the right moment

PROGRAMME OUTCOMES (PO)

On completion of M.Sc. ZOOLOGY Programme, the graduates would be able to

PO 1	Apply acquired scientific knowledge to solve major and complex issues in the society/industry.
PO 2	Attain research skills to solve complex cultural, societal and environmental issues.
PO 3	Employ latest and updated tools and technologies to solve complex issues.
PO 4	Demonstrate Professional Ethics that foster Community, Nation and Environment Building Initiatives.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of M.Sc. ZOOLOGY programme, the graduates would be able to

PSO 1	Gain comprehensive knowledge in different branches of zoology – Cell & Molecular Biology, Biochemistry, Microbiology, Developmental Biology, Immunology, Genetics, Biotechnology, Bioinformatics and Evolution.
PSO 2	Interrelate the concepts of gene, genome, cell, tissue, organ and organ-system in the physiological adaptations, development, reproduction, behaviour of microbes, plants and animals
PSO 3	Perform experiments in the field of Microbiology, Biochemistry, Cell & Molecular Biology, Environmental Biology, Developmental Biology, Biostatistics, Immunology, Genetics, Biotechnology and Bioinformatics.
PSO 4	Develop empathy towards conservation of plants and animals and appreciate the diversity of animals and their inclusiveness in the sustenance of an ecosystem.
PSO 5	Express ideas and concept through oral presentation and organize research data in the form of dissertation writing.
PSO 6	Solve the environmental, social and ethical problems by applying the biological principles for minimizing pollutants by waste water treatment and solid waste management for eco-sustainable development.
PSO 7	Address the local, regional, national and global environmental issues and mitigating the same through Intervention strategies adopting standard protocol.
PSO 8	Practice judicious way of using animals in experiments, proper disposal of hazardous biological waste and ethics related to conserving endangered animals and plants.
PSO 9	Exhibit the holistic growth by developing interpersonal skills, subject proficiency, and to seek employability in clinical laboratory, Research institutions, Medical coding and IT companies.
PSO 10	Make them self employed/ Entrepreneur in the field of Sericulture, Fisheries and Aquaculture, Dairy farming, Apiculture and Poultry.

PSO 11	Use of computers for Power point presentation, Virtual Dissection, analysis of bio- molecules using bioinformatics software and computing biological data.
PSO 12	Healthy diet pattern for combat life style disorder.

DEPARTMENT OF ZOOLOGY

For those who joined in June 2019 onwards

MAJOR CORE – 70 CREDITS

PROGRAMME CODE:

S. No	SEM.	COURSE CODE	COURSE TITLE	HRS	CREDITS	CIA Mks	ESE Mks	TOT. MKs
1.	I	23PG1Z1	Structure and Function of Invertebrates	7	5	40	60	100
2.		23PG1Z2	Comparative Anatomy of Vertebrates	7	5	40	60	100
		23PG1Z3	Lab Course in Invertebrates &Vertebrates	6	5	40	60	100
3.	II	23PG2Z4	Cell and Molecular Biology	6	5	40	60	100
4.		235G2Z5	Developmental Biology	6	5	40	60	100
5.		23PG2Z6	Lab Course in Cell Biology & Developmental Biology	6	4	40	60	100
6.	III	19PG3Z11	Biophysics	6	5	40	60	100
7.		19PG3Z12	Immunology	6	5	40	60	100
8.		19PG3Z13	Biostatistics &Research Methodology	6	5	40	60	100
9.		19PG3Z14	Lab in Biophysics &Biostatistics	4	2	40	60	100
10.		19PG3Z15	Lab in Immunology, Fisheries &Aquaculture and Bioinformatics	4	2	40	60	100
11.	IV	19PG4Z16	Environmental Biology	6	5	40	60	100
12.		19PG4Z17	Biotechnology	6	5	40	60	100
13.		19PG4Z18	Developmental Biology	6	5	40	60	100
14.		19PG4Z19	Lab in Environmental Biology &Developmental Biology	4	2	40	60	100
15.		19PG4Z20	Lab in Biotechnology, Economic Zoology & Ethology	4	2	40	60	100
			TOTAL	**104**	**70**			

MAJOR ELECTIVE / EXTRA DEPARTMENTAL COURSE / INTERNSHIP/ PROJECT -20 CREDITS

S. No	SEM.	COURSECODE	COURSE TITLE	HRS	CREDITS	CIA Mks	ESE Mks	TOT. Mks
1.	I	23PG1ZE1/ 23PG1ZE2	Molecules and their interaction relavant to Biology / Fisheries &Aquaculture	5	3	40	60	100
2.		23PG1ZE3/ 23PG1ZE4	Biostatistics/ Environmental Toxicology	5	3	40	60	100
3.		23PG1ZAE	Sericulture	2	2	40	60	100
4.	II	23PG2ZE5 /23PG2ZE6	Economic Entomology/ / Microbiology	4	3	40	60	100
5.		23PG2ZE7 /23PG2ZE8	Research Methodology / Biophysics	4	3	40	60	100
6.		23PG2ZEA	Poultry Farming	4	2	40	60	100
7.	III	19PG3ZE1/ 19PG3ZE2	Fisheries & Aquaculture / Bioinformatics	4	4	40	60	100
8.		19PG3ZSI	Summer Internship	-	3	40	60	100
9.	IV	19PG4ZE3/ 19PG4ZE4	EconomicZoology/ Ethology	4	4	40	60	100
10.		19PG4ZPR	Project*&Viva Voce	-	3	50	50	100
			TOTAL	**14**	**20**			

OFF-CLASS PROGRAMMES

ADD-ON COURSES

COURSE CODE	COURSES	HRS.	CREDITS	SEMESTER IN WHICH THE COURSE IS OFFERED	CIA MKS	ESE MKS	TOTAL MARKS
19PAD2SS	**SOFT SKILLS**	40	3	I	40	60	100
19PAD2CA	• **COMPUTER APPLICATIONS** ComputerApplication forBiologists /SPSS	40	4	II	40	60	100
19PAD4CV	**COMPREHENSIVE VIVA**(Question bank to be prepared for all the courses by the respective course teachers)	-	2	IV	-	-	100
19PAD4RC	**READING CULTURE**	2	1	I- II	-	-	-
	TOTAL		**10**				

EXTRA CREDIT COURSES

Course Code	Courses	Hrs.	Credits	Semester in which the course is offered	CIA Mks	ESE Mks	Total Marks
21PG2ZSL	**SELF LEARNING COURSES for ADVANCED LEARNERS** Fermentation Technology	-	2	II	40	60	100
21PG4ZSL	Vector Borne Disease	-	2	IV	40	60	100

- **Lab Courses:**
  - A range of 10-15 experiments per semester

- **Summer Internship:**
  - Duration-1 month (2nd Week of May to 2nd week of June-before college reopens)
- **Project:**
  - Off class
  - Evaluation components-Report writing + Viva Voce (Internal marks-40) + External marks 60

- **EDC:**Syllabus should be offered for two different batches of students from other than the parent department inSem-I &Sem-II

I M.Sc. Zoology

SEMESTER – I

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG1Z1	Structure and Function of Invertebrates	Theory	6	5

COURSE DESCRIPTION

This course provides an overview of the Invertebrate and Vertebrate animals byfocussing on the General characters, Classification, Special features and Biology ofsome selected Invertebrates.

COURSE OBJECTIVES

- To understand the concept of classification and their characteristic features of major group of invertebrates.
- To realize the range of diversification of invertebrate animals.
- To enable to find out the ancestors or derivatives of any taxon.
- To know the functional morphology of system biology of invertebrates.

UNITS

UNIT I **(21 Hrs)**

Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy.

UNIT II **(21 Hrs)**

Organization ofcoelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia andDeuterostomia; Locomotion: Flagella and ciliary movement inProtozoa; Hydrostatic movement in Coelenterata, Annelida andEchinodermata.

UNIT III **(21 Hrs)**

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration.

UNIT IV **(21 Hrs)**

Excretion:
Organsofexcretion:coelom,coelomoducts,NephridiaandMalphigiantubules; Mechanisms ofexcretion; Excretion andosmoregulation. Nervoussystem: Primitive nervous system: Coelenterata andEchinodermata;Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neuralevolution.

UNIT V **(21 Hrs)**

Invertebrate larvae: Larval forms of free living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Concept and significance; Organization and general characters.

REFERENCES:

1. Kotpal R.L. (2020). Modern Text Book of Zoology Invertebrates (12 thed), Rastogi Publications, Meerut, 2020
2. Kashyap.V (2019). A Text Book of Invertebrate Zoology. KedarNath Ram Nath Publications, Meerut, 2019.
3. Jordan E.L., and Verma P.S. (2012). *Invertebrate Zoology*, S.Chand& Co, New Delhi, 2012.
4. Prasad S.N.(1989). *Invertebrate Zoology*, Vikas publishing House Pvt Ltd, India, 1989.
5. Newman. H.H (1987). *The Phylum Chordata*, Satish Book Enterprise, Motikala.

6. EkambaranathaAyyar M. and Ananthakrishnan T.N. (1981). A manual of Zoology, Part-II (Chordate), Viswanathan (Printers and Publishers) Pvt. Ltd, Chennai

7. Young J.Z. (1962). *The Life of Vertebrates*. Oxford University Press, New York, ed. 2, 1962

8. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.

9. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.

3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition).Published by McGraw Hill Education (India) Private Limited, pp-624.

Web Resources

DIGITAL OPEN EDUCATIONAL RESOURCES

1. https://www.oercommons.org/courseware/lesson/15073/overview
2. https://opened.cuny.edu/courseware/lesson/753/overview
3. https://www.nationalgeographic.com/animals/invertebrates/
4. https://bit.ly/3kABzKa
5. https://www.nio.org/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT ISTRUCTURE AND FUNCTION IN INVERTEBRATES				
1.1	Structure and function in invertebrates: Principles of Animal taxonomy;	6	Chalk & Talk	Black Board
1.2	Species concept;	5	Chalk & Talk	Black Board

1.3	International code of zoological nomenclature;	5	Chalk & Talk	PPT
1.4	Taxonomic procedures;	5	Chalk & Talk	LCD
UNIT -2 ORGANIZATION OF COELOM				
2.1	Organization ofcoelom: Acoelomates; Pseudocoelomates; Coelomates:	6	Chalk & Talk	Black Board
2.2	Protostomia andDeuterostomia;	5	Chalk & Talk	Black Board
2.3	Locomotion: Flagella and ciliary movement inProtozoa;	5	Chalk & Talk	PPT
2.4	Hydrostatic movement in Coelenterata, Annelida andEchinodermata.	5	Chalk & Talk	LCD
UNIT -3 NUTRITION AND DIGESTION				
3.1	Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan;	5	Chalk & Talk	Black Board
3.2	Filter feeding in Polychaeta, Mollusca and Echinodermata.	5	Chalk & Talk	Black Board
3.3	Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments;	6	Chalk & Talk	PPT
3.4	Mechanism of respiration.	5	Chalk & Talk	LCD
UNIT -4 EXCRETION				

4.1	Excretion: Organsofexcretion:coelom,coelomoducts,NephridiaandMalphigiantubules;	4	Chalk & Talk	Black Board
4.2	Mechanisms ofexcretion;	4	Chalk & Talk	Black Board
4.3	Excretion andosmoregulation.	3	Chalk & Talk	PPT
4.4	Nervoussystem: Primitive nervous system: Coelenterata andEchinodermata;	4	Chalk & Talk	LCD
4.5	Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda);	3	Lecture	PPT
4.6	Trends in neuralevolution.	3	Chalk & Talk	Black Board
UNIT -5 INVERTEBRATE LARVAE				
5.1	Invertebrate larvae: Larval forms of free living invertebrates	5	Chalk & Talk	Black Board
5.2	Larval forms of parasites;	5	Chalk & Talk	PPT
5.3	Strategies and Evolutionary significance of larval forms.	5	Chalk & Talk	LCD
5.4	Minor Phyla: Concept and significance; Organization and general characters.	6	Lecture	PPT

Components	**Marks**	**Converted Marks**
T1	**30**	**15**

T2	**30**	
Assignment		**3**
Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**	PSO1, PSO2
CO 2	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**	PSO1, PSO2
CO 3	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**	PSO1, PSO3, PSO7
CO 4	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**	PSO1, PSO3

CO 5	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**	PSO1, PSO4

Mapping COs Consistency with PSOs

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	S	M	M	M	S	M	M	M
CO2	M	S	M	M	M	M	M	M
CO3	S	M	M	S	M	M	M	M
CO4	S	M	M	S	S	M	M	M
CO5	S	M	S	M	M	M	M	M

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	S	S	M	S
CO2	S	S	M	M
CO3	S	M	S	M
CO4	S	M	S	M
CO5	S	M	S	M

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2** ♦ Weakly Correlated -**1**

Forwarded By

HOD'S Signature & Name

I M.Sc. Zoology

SEMESTER – I

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
UAZO	23PG1Z2	Comparative Anatomy of Vertebrates	Theory	6	5

COURSE DESCRIPTION

This course familiarizes the invertebrate phyla, and their anatomy. It also provides special attention to lower invertebrates of economic and medical importance to the human environment.

COURSE OBJECTIVES

- To understand the structures and distinct features of invertebrate phyla.
- To understand and able to distinguish the characteristic features of each phylum
- To understand the economic importance of invertebrates

- To understand the interaction of invertebrates with the environment.
- To understand the evolutionary position of different groups of invertebrates

UNITS

Unit I

Origin of vertebrates: Concept ofProtochordata; The nature of vertebratemorphology; Definition,scopeandrelationtootherdisciplines; Importance of the study of vertebratemorphology.

Unit II

Origin and classification of vertebrates; Vertebrate integument and itsderivatives.Development,generalstructureandfunctionsofskinanditsderivatives; Glands, scales, horns, claws, nails, hoofs, feathers andhairs.

Unit III

General plan of circulation in variousgroups; Blood; Evolution ofheart; Evolution of aortic arches and portalsystems. Respiratorysystem: Characters of respiratorytissue; Internal and external respiration; Comparative account of respiratoryorgans

Unit IV

Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jawsuspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.

Unit V

Senseorgans: Simplereceptors; Organs of Olfaction andtaste; Lateral linesystem; Electroreception. Nervous system: Comparative anatomy of the brain in relation to itsfunctions; Comparative anatomy of spinalcord; Nerves-Cranial, Peripheral and Autonomous nervoussystems.

REFERENCES:

Text Books

1. SwayamPrabha https://www.swayamprabha.gov.in/index.php/program/archive/9
2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.

3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.

References Books

Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.

Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.

EkambaranathaAyyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. ViswanathanPvt. Ltd. Chennai.

Kotpal, 2019.R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

DIGITAL OPEN EDUCATIONAL RESOURCES

1. https://www.nationalgeographic.com/animals/invertebrates/
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://bit.ly/3lJdUX0

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 ORIGIN OF VERTEBRATES				
1.1	Origin of vertebrates	2	Chalk and Talk	Black Board
1.2	Concept ofProtochordata	3	Chalk and Talk	Black Board
1.3	The nature of vertebratemorphology	3	Chalk and Talk	Black Board

1.4	Importance of the study of vertebratemorphology	2	Chalk and Talk	Black Board
1.5	Definition,scopeandrelationto otherdisciplines	2	Chalk and Talk	Black Board
UNIT -2 ORIGIN AND CLASSIFICATION OF VERTEBRATES				
2.1	Origin and classification ofvertebrates;.	3	Chalk and Talk	Black Board
2.2	Vertebrate integument and itsderivatives	3	Chalk and Talk	Black Board
2.3	Development,generalstructureandfunctionsofskinanditsderivatives; Glands, scales, horns, claws, nails, hoofs, feathers andhairs.	6	Chalk and Talk	Black Board
UNIT -3 CIRCULATION AND RESPIRATION				
3.1	General plan of circulation in variousgroups;	1	Chalk and Talk	Black Board
3.2	Blood; Evolution ofheart;	3	Chalk and Talk	Black Board
3.3	Evolution of aortic arches and portalsystems.	3	Lecture	PPT & White Board
3.4	Respiratorysystem: Characters of respiratorytissue; Internal and external respiration;	2	Chalk and Talk	Black Board
3.5	Comparative account of respiratoryorgans	3	Chalk and Talk	Black Board
UNIT IV: **SKELETAL SYSTEM**				

4.1	Skeletalsystem: Form, function, body size and skeletal elements of thebody;	4	Chalk and Talk	Black Board
4.2	Comparative account of jawsuspensorium,	2	Lecture	PPT & White Board
4.3	Vertebral column; Limbs andgirdles	3	Chalk and Talk	Black Board
4.4	Evolution of Urinogenital system in vertebrateseries	3	Chalk and Talk	Black Board
UNIT V: SENSE ORGANS				
5.1	Senseorgans: Simplereceptors; Organs of Olfaction andtaste;.	3	Chalk and Talk	Black Board
5.2	Lateral linesystem; Electroreception.	3	Chalk and Talk	Black Board
5.3	Nervous system: Comparative anatomy of the brain in relation to itsfunctions;	2	Lecture	PPT & White Board
5.4	Comparative anatomy of spinalcord; Nerves-Cranial,	3	Chalk and Talk	Black Board
5.5	Peripheral and Autonomous nervoussystems	1	Chalk and Talk	Black Board

Components	**Marks**	**Converted Marks**
T1	**30**	**15**
T2	**30**	
Assignment		**3**

Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**	PO1
CO 2	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**	PO1, PO2
CO 3	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**	PO3, PO4, PO5
CO 4	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**	PO4, PO5, PO6
CO 5	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**	PO1, PO2, PO3, PO8

Mapping of COs with PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0

CO1	S	M	L	S	M	S	M	S	M	S
CO2	S	L	L	S	M	S	M	M	M	M
CO3	S	M	L	S	M	S	M	L	M	M
CO4	S	L	L	S	L	S	M	L	M	L
CO5	S	M	L	S	S	S	M	S	M	M

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

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**S**	**M**	**M**	**M**
CO2	**S**	**M**	**M**	**M**
CO3	**S**	**M**	**M**	**M**
CO4	**S**	**M**	**M**	**M**
CO5	**S**	**M**	**M**	**M**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**
□ Weakly Correlated -**1**

COURSE DESIGNER:

Forwarded By

HOD'S Signature
& Name

I M.Sc.,ZOOLOGY

SEMESTER –I

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	**23PG1Z3**	**Lab Course in Invertebrates & Vertebrates**	**Practical**	**6**	**4**

COURSE DESCRIPTION

This course will give a thorough investigation of Invertebrates and Chordates, looking at the anatomy and contrasting the characteristics.

COURSE OBJECTIVE

- Understand the fundamental organization of animals.
- Reorganization of the anatomy of the body plan in invertebrates and vertebrates, at the level of organs and systems.
- Identification of their morphological and anatomical structures.

INVERTEBRATES

Dissection (Demo/ Virtual dissection)

Earthworm : Nervous system
Pila : Digestive and nervous systems
Sepia : Nervous system
Cockroach : Nervous system
Grasshopper : Digestive system and mouth parts
Prawn : Appendages, nervous and digestive systems
Crab : Nervous system

Study of the following slides with special reference to their salient features and their modes of life

1. *Amoeba*
2. *Entamoebahistolytica*
3. *Paramecium*
4. *Hydra* with bud
5. Sporocyst – Liver fluke
6. *Cercaria*larva
7. *Tape worm (Scolex)*
8. *Ascaris*T. S.
9. Mysis of prawn

Spotters

1. Scorpion
2. *Penaeusindicus*
3. *Emerita* (*Hippa*)
4. *Pernaviridis*

Mounting

Earthworm : Body setae
Cockroach : Mouth parts
Grasshopper: Mouth parts

CHORDATES

Study the nervous system of Indian dog shark – Dissection (Demo/ Virtual dissection)

1. Nervous system of *Scoliodonlaticaudatus* – 5th or Trigeminal nerve
2. Nervous system of *Scoliodonlaticaudatus* – 7th or Facial nerve
3. Nervous system of *Scoliodonlaticaudatus* – 9th and 10th

or Glossopharyngeal &Vagus nerve

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodonlaticaudatus*(Indian dog shark)
4. *Trygon*sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus*(Cat fish)
7. *Belone cancila*(Flute fish)
8. *Exocoetuspoecilopterus*(Flying fish)
9. *Mugilcephalus*(Mullet)
10. *Tilapia mossambicus*(Tilapia)
11. *Rachycentroncanadum*(Cobia)
12. *Tetrodon punctatus* (Puffer fish)
13. *Dendrophis*sp. (Tree snake)

Study of the different types of scales in fishes
1. Cycloid scale
2. Ctenoid scale
3. Placoid scale

Study of the frog skeleton system (Representative samples)

1. Entire skeleton
2. Skull
3. Hyoid apparatus
4. Pectoral girdle and sternum
5. Pelvic girdle
6. Fore limb
7. Hind limb

Mounting
1. Weberian ossicles of fish

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.

Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):.

1. https://oercommons.org/search?f.search=vertebrates
2. https://oercommons.org/courseware/lesson/15077/overview
3. https://oercommons.org/courseware/lesson/15083/overview?section=9
4. https://animaldiversity.org/
5. https://www.oercommons.org/courses/creaturecast-anurida

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
Invertebrates				
1.	Earthworm : Nervous system	4	Demonstration and Hands on training	Earthworm
2.	*Pila* : Digestive and nervous systems	4	Demonstration and Hands on training	Pila
3.	*Sepia* : Nervous system	4	Demonstration and Hands on training	Sepia
4.	Cockroach : Nervous system	4	Demonstration	Cockroach
5.	Grasshopper : Digestive system and mouth parts	4	and Hands on training	Grasshopper
6	Prawn : Appendages, nervous and digestive systems	4	Demonstration	Prawn
7	Crab : Nervous system	4	and Hands on training	Crab
8	SLIDES Amoeba Entamoebahistolytica Paramecium Hydra with bud Sporocyst – Liver fluke Cercaria larva Tape worm (Scolex) Ascaris T. S. Mysis of prawn	4		
9	**SPOTTERS** Scorpion *Penaeusindicus* *Emerita* (*Hippa*) *Pernaviridis*	4	Explanation	Spotters

7.	**Mounting** Prochordata – Amphioxus (entire); Chordata – Anguilla (Eel), Toad (Bufo), Hyla, Ichthyophis, Cobra, Viper, Enhydrina, Chamaeleon, Draco, Chelone, Echidna, Manis	4	Explanation	Spotters
8	Earthworm : Body setae	4	Explanation	
9	*Pila* : Radula	4	Demonstration and Hands on training	
10	Cockroach : Mouth parts	4	Demonstration and Hands on training	Nutrient Agar and Broth
11	Grasshopper : Mouth parts	4	Demonstration and Hands on training	Soil, Water and Food
Chordates				
CHORDATES				
	Study the nervous system of Indian dog shark - Dissection 1. Nervous system of *Scoliodonlaticaudatus* – 5th or Trigeminal nerve 2. Nervous system of *Scoliodonlaticaudatus* – 7th or Facial nerve 3. Nervous system of *Scoliodonlaticaudatus* – 9th and 10th or	4	Virtual dissection	

	Glossopharyngeal &Vagus nerve			
	Study of the following specimens with special reference to their salient features and their modes of life 1. *Amphioxus* sp. (Lancelet) 2. *Ascidia* sp. (sea squirt) 3. *Scoliodonlatica udatus*(Indian dog shark) 4. *Trygon*sp. (Sting ray) 5. *Torpedo* sp. (Electric ray) 6. *Arius maculatus*(Cat fish) 7. *Belone cancila*(Flute fish) 8. *Exocoetuspoeci lopterus*(Flying fish) 9. *Mugilcephalus*(Mullet) 10. *Tilapia mossambicus*(Tila pia) 11. *Rachycentronc anadum*(Cobia) 12. *Tetrodon punctatus* (Puffer fish) 13. *Dendrophis*sp. (Tree snake)	4	Virtual dissection	Bacteria
	Study of the different types of scales in fishes 1. Cycloid scale 2. Ctenoid scale 3. Placoid scale	4	Demonstratio n and Hands on training	Fish scales

	Study of the frog skeleton system (Representative samples) 1. Entire skeleton 2. Skull 3. Hyoid apparatus 4. Pectoral girdle and sternum 5. Pelvic girdle 6. Fore limb 7. Hind limb	4	Virtual dissection	
	Mounting 1. Weberian ossicles of fish	4	Demonstration and Hands on training	Fish

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Understand the structure and functions of various systems in animals	**K2 & K4**	PSO1& PSO2
CO 2	Learn the adaptive features of different groups of animals	**K1 & K2**	PSO2
CO 3	Learn the mounting techniques	**K2 & K3**	PSO5
CO 4	Acquire strong knowledge on the animal skeletal system	**K2 & K4**	PSO8 & PSO9

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 5	Learn the salient features and their modes of life	**K2 & K4**	

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**
CO1	S	S	S	M	S	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

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

COURSE DESIGNER:

Forwarded By

HOD'S Signature & Name

I M.Sc. Zoology

SEMESTER – I

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG1ZE1	Molecules and their interaction relevant to Biology	Lecture	5	3

COURSE DESCRIPTION

The course is designed to provide firm foundation in the principles of Biochemistry by providing knowledge on structure, biochemical properties of biomolecules and the role of these biomolecules in the major metabolic pathways of a living system.

COURSE OBJECTIVES

- Learn the structure, properties, metabolism and bioenergetics of Biomolecules

- Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation
- Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers
- Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures
- Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids

UNITS

Unit I

Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

Unit II

Biomolecular interactions and their properties:Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

Unit III

Bioenergetics and enzymology:Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes

Unit IV

Structural conformation of proteins and nucleic acids:Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).

Unit V

Stabilizing interactions in biomolecules:Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.

Self Study -Parathyroid Gland, Pancreas, Adrenal Gland

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)

REFERENCES:

1. Satyanarayana U., and ChakrapaniU.(2014)*Biochemistry, 4th Revised ed,* Reprinted. Elsevier, Reed Elsevier India Private Limited, New Delhi and Books and Allied (P) Ltd., Kolkata.
2. Rastogi S.C. (2006) *Biochemistry, 2nded, 5th Reprint.* Tata McGraw-Hill Publishing Company Limited, New Delhi).
3. Lehninger L.A., Nelson D.L and Cox M.M.(2005)*Principles of Biochemistry, 5th ed.*, W.H.Freeman and Company, New York.
4. Conn E.E., Stumpf P.K., Bruening G and Doi R.H. (2004). *Outlines of Biochemistry, 5th ed.*, John-Wiley and Sons, Singapore.
5. StryerL.(2003)*Biochemistry, 5th ed.*, W.H.Freeman Publishers, New York.
6. Murray K.R., Granner D.K., Mayer A.P and RodwellV.W.(2000)*Harper's Biochemistry, 25th ed.*, Appleton and Lange.
7. Devlin M.T.(1997) *Textbook of Biochemistry with Clinical Correlations,* Wiley-Liss Pub, New York.
8. Montgomery R., Conway T.W., Spector A.A and Chapell D. (1996) *Biochemistry – A case oriented approach, 6th ed.,* Mosby Inc., London.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. http://www.oercommons.org/courses/biochemistry-3/view
2. https://openlab.citytech.cuny.edu/bio-oer/chemistry/biologically-important-macromolecules/proteins/
3. https://www.open.edu/openlearn/science-maths-technology/science/biology/proteins/content-section-1.1

4. https://ocw.mit.edu/high-school/biology/exam-prep/chemistry-of-life/enzymes/
5. http://www.iubmb-nicholson.org/chart.html

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1				
1.1	Structure of atoms,	2	Chalk & Talk	Black Board
1.2	Structure of molecules	2	Lecture	PPT
1.3	Structure of chemical bonds	3	Chalk & Talk	Green Board
1.4	Principles of biophysical chemistry (pH, buffer,	2	Lecture	PPT
1.5	reaction kinetics	3	Chalk & Talk	Black Board
1.6	Thermodynamics	3	Lecture	Black Board
1.8	colligative properties	3	Lecture	LCD
UNIT -2				
2.1	Biomolecular interactions and their properties:Stabilizing interactions (Vander Waals, electrostatic,	1	Lecture	Green Board
2.2	hydrogen bonding, hydrophobic interaction etc. -	2	Chalk & Talk	Green Board
2.3	Composition, structure, metabolism and function of biomolecules (carbohydrates,	3	Lecture	Smart Board

2.4	lipids,	3	Lecture	Board
2.5	proteins,	3	Lecture	LCD
2.6	nucleic acids	2	Chalk & Talk	Black Board
2.7	Vitamins	1	Chalk & Talk	Black Board
UNIT -3				
3.1	Bioenergetics and enzymology:Bioenergetics,	3	Chalk & Talk	Black Board
3.2	glycolysis, oxidative phosphorylation, coupled reaction,	3	Lecture	LCD
3.3	group transfer, biological energy transducers -	3	Lecture	LCD
3.4	Principles of catalysis, enzymes and enzyme kinetics,	3	Lecture	LCD
3.5	enzyme regulation, mechanism of enzyme catalysis, isoenzymes	3	Lecture	LCD
4.1	Structural conformation of proteins and nucleic acids:Conformation of proteins Ramachandran plot	2	Chalk & Talk	Black Board
4.2	-Conformation of nucleic acids (A-, B-, Z-DNA),	4	Lecture	LCD
4.3	Conformation of nucleic acids (A-, B-, Z-DNA),	4	Lecture	LCD
4.4	t-RNA, micro-RNA).	3	Lecture	PPT
5.1	Stabilizing interactions in biomolecules:Stability of protein	2	Chalk & Talk	Black Board

5.2	Stability of nucleic acid structures	1	Lecture	Green Board
5.3	hydrogen bonding,	2	Lecture	PPT
5.4	covalent bonding,	3	Lecture	LCD
5.5	hydrophobic interactions and disulfide linkage.	1	Discussion	Google classroom

Components	**Marks**	**Converted Marks**
T1	**30**	**15**
T2	**30**	
Assignment		**3**
Quiz / Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	**COURSE OUTCOMES**	**KNOWLEDGE LEVEL**	**PSOs ADDRESSED**

		(ACCORDING TO REVISED BLOOM'S TAXONOMY)	
CO 1	Analyse the Structure of atoms, molecules and chemical bonds	**K4**	PSO1,PSO2,PSO4,PSO 8
CO 2	Recall the structure, properties and metabolism of biomolecules.	**K1**	PSO1,PSO2,PSO4,PSO 8
CO 3	Assess the mechanism of enzyme action.	**K5**	PSO1,PSO2,PSO4,PSO 8
CO 4	Identify the thestructural conformation of proteins and nucleic acids	**K3**	PSO1,PSO2,PSO4,PSO 8
CO 5	Describe the stabilization of interactions in biomolecules	**K2**	PSO1,PSO2,PSO4,PSO 8

Mapping COs Consistency with PSOs

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping of COs with POs

CO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	3	3	3	3	3	3	3	3	3	2
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	2	3	3	3	3
CO4	2	2	3	3	3	3	3	3	2	2
CO5	2	3	2	2	2	2	2	2	2	2

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2** ♦ Weakly Correlated -**1**

COURSE DESIGNER:

Forwarded By

HOD'S Signature & Name

Elective Course - Discipline Specific

I M.Sc., ZOOLOGY

SEMESTER –I

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG1ZE2	Fisheries & Aquaculture	Lecture	5	3

COURSE DESCRIPTION

This Course focuses on Fisheries and Aquaculture of Finfishes, Marine Prawn, Pearl Oyster and Disease Management.

COURSE OBJECTIVES

To impart knowledge on Fisheries and Aquaculture Practices in India.

UNIT I - INDIAN CAPTURE FISHERIES (15 HRS)

History of Fisheries, Indian Capture Fisheries: Riverine fisheries, Estuarine fisheries, Reservoir fisheries, Lacustrine Fisheries, Cold-water fisheries; Marine Capture fisheries.

UNIT II - AQUACULTURE PRACTICES (15HRS)

Preparation and Construction of Ponds; Water Quality Management;Maintenance of Fish Farms; Fish Nutrition – Live feed, Artificial feed - FCR; Induced Breeding – Eyestalk ablation and Hypophysation.

UNIT III - CULTURE SYSTEMS (15 HRS)

Culture Systems – Based on habitat, expenses, site, climatic conditions and Composition of Organisms Culture of Indian Major Carps, Marine Prawn, Pearl Oyster and Sea Cucumber - Sewage fed fish culture, Integrated Fish Farming.

UNIT IV - FISH PATHOLOGY AND POST HARVEST TECHNOLOGY (15 HRS)

Parasitic diseases – Protozoan, Helminth, Crustacean, Fungal, Bacterial and Viral diseases and Deficiency Diseases; Preservation of Fish – Processing of Prawn; Fish Marketing – Domestic Market – Marine, Brackish &Inland Marketing & Export Market.

UNIT V - INDIAN FISHERIES &AQUACULTURE ECONOMICS (15 HRS)

Indian Fishing Gears and Methods, Fishing Crafts; Role of Government and Public Sector on Indian Fisheries, FFDAs.Economics of Fisheries and Aquaculture.

REFERENCE BOOKS:

1. Pandey K. and Shukla J.P., (2012) *Fish and Fisheries*, 3rd Revised ed., Rastogi Publications, Meerut.

2. Srivastava C.B.L., (2008) *A Textbook of Fishery Science and Indian Fisheries*, 3rd Revised ed., Published by KitabMahal, Allahabad.

3. Kumar R., (2012) *Fish Farming Management*, 1st ed., Arise Publishers and Distributors, New Delhi.

4. Chandrasekhar Y.S., (2013) *Fish Nutrition in Aquaculture*, 1st ed., Swastik Publications, New Delhi.

5. Reddy S.M. and Sambasiva Rao K.R.S., (1999) *A Textbook of Aquaculture*, Discovery Publishing House, New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.fao.org/3/l9805e/l9805e00.htm#
2. http://ecoursesonline.iasri.res.in/course/index.php?categoryid=72

3. https://nfdb.gov.in/
4. https://indianfisheries.icsf.net/
5. https://www.india.gov.in/topics/agriculture/fisheries
6. http://eprints.cmfri.org.in/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT-1 INDIAN CAPTURE FISHERIES				
1.1	History of Fisheries	2	Chalk & Talk	Black Board
1.2	Indian Capture Fisheries: Riverine fisheries, Estuarine fisheries, Reservoir fisheries, Lacustrine Fisheries, Cold-water fisheries	8	Chalk & Talk	LCD
1.3	Marine Capture fisheries: Inshore capture fisheries, Off shore and deep sea fisheries	5	Lecture	PPT & White board
UNIT-2 AQUACULTURE PRACTICES				
2.1	Preparation and Construction of Ponds	5	Lecture	Charts
2.2	Water Quality Management	3	Chalk & Talk	PPT& Videos
2.3	Maintenance of Fish Farms	2	Chalk & Talk	PPT
2.4	Fish Nutrition – Live feed, Artificial feed – FCR	3	Chalk & Talk	PPT& Videos
2.5	Induced Breeding – Eyestalk ablation and Hypophysation	2	Chalk & Talk	PPT

UNIT-3 CULTURE SYSTEMS				
3.1	Culture Systems – Based on habitat, expenses, site, climatic conditions and Composition of Organisms	2	Lecture	PPT& Videos
3.2	Culture of Indian Major Carps, Marine Prawn, Pearl Oyster and Sea Cucumber	8	Lecture	PPT& Videos
3.3	Sewage fed fish culture	2	Chalk & Talk	PPT& Videos
3.4	Integrated Fish Farming.	3	Chalk & Talk	PPT& Videos
UNIT-4 FISH PATHOLOGY AND POST HARVEST TECHNOLOGY				
4.1	Parasitic diseases – Protozoan, Helminth, Crustacean, Fungal, Bacterial and Viral diseases and Deficiency Diseases	10	Chalk & Talk	PPT& Videos
4.2	Preservation of Fish	2	Chalk & Talk	PPT& Videos
4.3	Processing of Prawn	1	Lecture	PPT& Videos
4.4	Fish Marketing	2	Lecture	PPT& Videos
UNIT-5 INDIAN FISHERIES				
5.1	Fishing Gears and Methods, Fishing Crafts	6	Chalk & Talk	PPT& Videos
5.2	Role of Government and Public Sector on Indian Fisheries, FFDAs.	5	Chalk & Talk	PPT& Videos
5.3	Economics of Fisheries and Aquaculture.	4	Chalk & Talk	PPT& Videos

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Identify the economically important fishes and fishery products.	**K1**	PSO1& PSO2
CO 2	Plans according to the recent concepts in fisheries management.	**K3**	PSO3
CO 3	Distinguish the various aquaculture systems.	**K2**	PSO5
CO 4	Organizes the type of hatchery, brood stock, larval production, feed management water quality and disease management in cultivable species, live feed production.	**K3**	PSO4, PSO9
CO 5	Evaluates the Fisheries and Aquaculture Practices in India.	**K4**	PSO5, PSO7 & PSO10

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10	PSO11	P
CO 1	3	2	2	2	2	2	2	2	2	2	2	
CO 2	2	2	3	2	2	2	2	3	2	2	2	

CO 3	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**
CO 4	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**3**
CO 5	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**-**	**3**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**2**	**2**
CO2	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**3**
CO4	**2**	**2**	**3**	**2**
CO5	**2**	**3**	**2**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

Dr. Antony AmalaJayaseeli

Forwarded By

HOD'S Signature & Name

I M.Sc. Zoology

SEMESTER – I

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
UAZO	23PG1ZE3	BIOSTATISTICS	Theory	5	3

COURSE DESCRIPTION

This course deals with specific procedures or techniques used to identify and process the research data.

COURSE OBJECTIVES

- Clear understanding of design and application of biostatistics relevant to experimental and population studies.
- Organise the research data in appropriate order and apply the measures of central tendency and dispersion values.
- Acquired skills to perform various statistical analyses using modern statistical techniques and software.
- Compute degrees of relationship variables using Correlation and Regression analysis
- Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.

UNITS

UNIT –I INTRODUCTION TO BIOSTATISTICS (15 HRS.)

Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

UNIT – II MEASURES OF CENTRAL TENDENCY (15 HRS)

Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error and coefficient of variation.

UNIT – IIIPROBABILITY (15 HRS)

Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.

UNIT – IV TESTING OF HYPOTHESIS (15 HRS)

Hypothesis testing: Student't' test - paired sample and mean difference't' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.

UNIT – V TEST OF VARIANCE (15 HRS)

Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

REFERENCES:

1. Khan and Khanum., (2018) *Fundamentals& Biostatistics*, 5thed., Ukaaz Publications, Hyderabad.
2. Palanichami S., Manoharan M (2008) Statistical Methods for Biologists (Biostatistics), Palani Paramount Publications, Palani.

3. Kothari. C.R., (2009). *Research Methodology*, New Age International,
4. Ramakrishnan P., (2010). Biostatistics, Saras publication, Nagercoil, Tamil Nadu.
5. Gurumani N., (2010). *An Introduction to Biostatistics*, MJP Publishers, Chennai.
6. Satguru Prasad., (2012). *Elements of Biostatistics,*Rastogi publications, Meerut.
7. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
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10. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
11. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
12. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
13. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
14. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

Web Resources

DIGITAL OPEN EDUCATIONAL RESOURCES

1. http://www.oercommons.org/courses/biostatistics-methods-2/view
2. https://www.oercommons.org/courses/chi-square-test-08-54
3. https://www.oercommons.org/courses/anova-calculations
4. https://www.oercommons.org/authoring/21429-wp-12-1-additional-test-of-two-population-variance/view
5. https://vivaopen.oercommons.org/courseware/unit/420

COURSE CONTENTS & LECTURE SCHEDULE:

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT - 1 COLLECTION & PROCESSING OF DATA				
1.1	Definition, scope and application of statistics	2	Chalk & Talk	Black Board
1.2	Primary and secondary data: Source and implications;	2	Chalk & Talk	Black Board
1.3	Classification and tabulation of biological data:Types and applications.	2	Lecture	PPT & White board
1.4	Variables: Definition and types.	2	Lecture	Black Board
1.5	Frequency distribution: Construction of frequency, distribution table for grouped data;	2	Lecture	Black Board
1.6	Graphic methods: Frequency polygon and ogive curve;	2	Lecture	Black Board
1.7	Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.	3	Lecture	Black Board
UNIT - 2 MEASURES OF CENTRAL TENDENCY AND DISPERSION				
2.1	Measures of central tendency: Mean and median for continuous and discontinuous variables.	3	Lecture	Black Board
2.2	Measures of central tendency: mode for continuous and discontinuous variables.	3	Chalk & Talk	Black Board

2.3	Measures of dispersion: Range, variation,	3	Chalk & Talk	Black Board
2.4	Standard deviation	3	Lecture	Black Board
2.5	Standard error and coefficient of variation.	3	Chalk & Talk	Black Board
UNIT – 3 PROBABILITY				
3.1	Probability: Theories and rules	3	Chalk & Talk	Black Board
3.2	Probability - Addition and multiplicationtheorem	2	Chalk & Talk	Black Board
3.3	Probability distribution: Properties of Normal, Binomial and Poisson distributions.	5	Chalk & Talk	Black Board
3.4	Probability distribution: Application of Normal, Binomial and Poisson distributions.	4	Lecture	Black board
UNIT - 4TESTING OF HYPOTHESIS				
4.1	Hypothesis testing: Student‘t’ test - paired sample and mean difference‘t’ tests.	4	Lecture	Black Board
4.2	Correlation: Types - Karl Pearsons Co-efficient, Rank correlation	4	Chalk &Talk	Black Board
4.3	Significance test for correlation coefficients.	3	Chalk & Talk	Black Board
4.4	Regression analysis: Computation of biological data,	4	Chalk & Talk	Black Board

	calculation of regression co-efficient, graphical representation and prediction.			
UNIT - 5 TEST OF VARIANCE				
5.1	Analysis of variance: one way and two way classification.	5	Lecture	Black Board
5.2	Analysis of variance: two-way classification.	5	Chalk &Talk	Black Board
5.3	Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).	5	Chalk & Talk	Black Board

Components	**Marks**	**Converted Marks**
T1	**30**	**15**
T2	**30**	
Assignment		**3**
Quiz / Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS

CIA	ESE	Total
25	75	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	K2 & K3	PO1
CO 2	Organise the research data in appropriate order and apply the measures of central tendency and dispersion values.	K3	PO1, PO2
CO 3	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	K3 & K4	PO4, PO6
CO 4	Compute degrees of relationship variables using Correlation and Regression analysis	K3	PO3, PO8
CO 5	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	K5 & K6	PO4, PO5, PO6

Mapping COs Consistency with PSOs

	Mapping with Programme Outcomes*										
	COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO1 0
	CO1	S	M	L	M	S	S	M	S	M	M
	CO2	S	S	S	S	S	S	S	S	S	S

	CO3	M	S	S	S	S	S	S	S	S	L
	CO4	M	M	S	L	M	M	M	S	L	M
	CO5	M	M	S	L	M	S	M	L	S	M

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

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**2**	**3**	**2**	**2**
CO2	**2**	**3**	**2**	**2**
CO3	**2**	**3**	**2**	**2**
CO4	**2**	**3**	**2**	**2**
CO5	**2**	**3**	**2**	**2**

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2** ♦ Weakly Correlated -**1**

Elective Course - Discipline Specific

I M.SC ZOOLOGY

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG1ZE4	Environmental Toxicology	Lecture	5	3

COURSE DESCRIPTION

The goal of this course is to introduce the student to the field of Environmental Toxicology where the basic principles of toxicology are applied to environmental problems.

COURSE OBJECTIVES

- Apply the knowledge to evaluate the exposure and solving problems associated with environmental contaminants.
- Use the skills, techniques and tools necessary for a successful career in the field of environmental toxicology.
- Conduct assessments of the environment, analyze data and evaluate health impacts from exposure to contamination.
- Understand contemporary environmental issues and the impact of environmental toxicology in a global and societal context.

UNITS

UNIT – I BASICS OF TOXICOLOGY (15 HRS)

Definition, History, Scope and Importance of Ecotoxicology; Classification of Environmental toxicants – food, atmosphere and hydrosphere; Dose-Response Relationship- concept, assumption, measurement and curves - the factors influencing Dose- Response relationship.

Self-Study: History and Scope of Ecotoxicology

UNIT – II TRANSPORT AND FATE OF TOXICANTS IN THE ENVIRONMENT (15 HRS)

Transport and Fate of Toxicants in the Environment – Source of toxicants to the Environment; transport Process – Advection and diffusion. Equilibrium Partitioning – Air and Water partitioning. Transformation Processes – reversible and irreversible reactions. Environmental Persistence – abiotic degradation, Biotic degradation and non -degradative elimination process.

Self-Study: Transport of Toxicants

UNIT III - TRANSLOCATION OF TOXICANTS (15 HRS)

Introduction Absorption, Distribution, Metabolism (Phase I and II) and Excretion/Elimination of Xenobiotics (ADME) – barriers of translocation. Ecological magnification – Factors that influence Bioaccumulation; Toxicokinetics - One Compartment Model.

Self-Study: Biomagnification - Factors that influence Bioaccumulation

UNIT – IV NATURE OF TOXICITY (15 HRS)

Toxicodynamics – introduction; Mechanisms of Toxicity of Pollutant-Organism level – Mortality, Disease Susceptibility, Behaviour, Cancer, Reproduction and development; Organ level; Environmental Risk Assessment.

UNIT – V METHODS OF TESTING (15 HRS)

Organization for Economic Cooperation and Development (OCED) – Guidelines.Toxicity Test - Acute and Chronic Toxicity –LC_{50}, EC_{50}, LOEC and NOEC. Biomarkers – Histology, Biochemical (Glucose), Enzymes (AChE) and genetic markers (Comet Assay). Receptors - Estrogen receptor (ER) and aryl hydrocarbon receptor (AHR).Ecological risk assessment. Ecotoxicogenomics – tools and applications.

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)

Reference

1. Sateake M., Mido Y., Sethi. M.S., S. A. Iqbal, Yasuhisa K and S. Taguchi. Environmental Toxicology. 2001. Second Edition .Discovery Publishing House, New Delhi – Tarun Offset Printers, Maujpur.
2. Ernest Hodgson 2004. A Textbook of Modern Toxicology. Third Edition. Edited By Ernest Hodgson. A John Wiley & Sons, Inc., Publication. New Jersey. Isbn 0-471-26508-X 1.
3. Walker CH, Hopkin SP, Sibly RM, Peakall DB. Principles of Ecotoxicology. 2nd edition. Taylor & Francis Group, 2001.
4. Casarett&Doull's Essentials of Toxicology. 3rd edition. Klaassen CD, Watkins JB. McGraw Hill, 2015. Also available on libraries.rutgers.edu (via accespharm) at https://bit.ly/3o0Tas
5. Omkar. Concepts of Toxicology. 2003. Publishing Soluyiyon, Jalandhar -144001.pp – 264.

DIGITAL OPEN EDUCATIONAL RESOURCES

1. https://www.niehs.nih.gov/health/topics/science/toxicology/index.cfm
2. https://www.toxicology.org/
3. https://www.epa.gov/chemical-research/ecotoxicology-ecotox-knowledgebase
4. http://npic.orst.edu/factsheets/ecotox.html
5. https://www.thebts.org/careers/ecotoxicology/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 BASICS OF TOXICOLOGY				
1.1	Definition, History, Scope	2	Chalk & Talk	Black Board
1.2	Importance of Ecotoxicology	1	Chalk & Talk	LCD
1.3	Classification of Environmental toxicants – food	2	Lecture	PPT & White board
1.4	Classification of Environmental toxicants atmosphere and hydrosphere	3	Discussion	LCD
1.5	Dose-Response Relationship-	2	Discussion	LCD
1.6	concept, assumption, measurement and curves -	3	Lecture	Black Board
1.7	factors influencing Dose-Response relationship.	2	Chalk & Talk	Black Board
UNIT -2 TRANSPORT AND FATE OF TOXICANTS IN THE ENVIRONMENT				
2.1	Transport and Fate of Toxicants in the Environment	1	Lecture	Green Board Charts
2.2	Source of toxicants to the Environment	2	Chalk & Talk	Green Board

2.3	transport Process – Advection and diffusion.	2	Chalk & Talk	Black Board
2.4	Equilibrium Partitioning – Air and Water partitioning.	2	Chalk & Talk	Black Board
2.5	Transformation Processes – reversible and irreversible reactions.	2	Lecture	PPT & White board
2.6	Environmental Persistence – abiotic degradation,	2	Lecture	Green Board
2.7	Biotic degradation	2	Chalk & Talk	Green Board
2.8	non -degradative elimination process.	2	Chalk & Talk	Black Board
UNIT -3 TRANSLOCATION OF TOXICANTS				
3.1	Introduction to ADME	1	Chalk & Talk	Black Board
3.2	Absorption, Distribution, Metabolism (Phase I and II) and Excretion/Elimination of Xenobiotics	6	Chalk & Talk	LCD
3.3	Barriers of translocation.	1	Lecture	PPT & White board
3.4	Ecological magnification	2	Discussion	LCD
3.5	Factors that influence Bioaccumulation;	2	Discussion	LCD

3.6	Toxicokinetics - One Compartment Model.	3	Lecture	Black Board
UNIT – 4 NATURE OF TOXICITY				
4.1	Toxicodynamics – introduction	1	Chalk & Talk	Black Board
4.2	Mechanisms of Toxicity of Pollutant	2	Chalk & Talk	LCD
4.3	Organism level – Mortality, Disease Susceptibility, Behaviour, Cancer,	2	Chalk & Talk	Black Board
4.4	Reproduction and development;	1	Chalk & Talk	Black Board
4.5	Organ level	4	Chalk & Talk	PPT
4.6	Environmental Risk Assessment.	2	Chalk & Talk	LCD
UNIT -5 METHODS OF TESTING				
5.1	Toxicity Test – OECD guidelines	1	Chalk & Talk	Black Board
5.2	Acute and Chronic Toxicity	2	Chalk & Talk	LCD
5.3	LC_{50}, EC_{50}, LOEC and NOEC.	2	Discussion	Black Board
5.4	Biomarkers – Histology, Biochemical, Enzymes and genetic markers.	5	Lecture	PPT & White board

5.5	Receptors - Estrogen receptor (ER) and aryl hydrocarbon receptor (AHR).	2	Lecture	PPT & White board
5.6	Ecological risk assessment .Ecotoxicogenomics – tools and applications.	3	Chalk & Talk	Black Board

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Summarize the scope, importance, types and dose – response relationship of environmental toxicants.	**K1**	PSO1, PSO2 PSO5 & PSO11
CO 2	Explain the transport and fate of toxicants in the environment.	**K2**	PSO1, PSO6, PSO7 & PSO11
CO 3	Organize the events in the translocation of toxicants.	**K3**	PSO1, PSO2, PSO3,PSO5 & PSO11
CO 4	Analyse the nature of toxicity at organism, Organ and environmental level.	**K4**	PSO1, PSO2 , PSO5 & PSO11

CO 5	Assess the various methods of testing environmental toxicants.	**K5**	PSO1, PSO2, PSO5 & PSO11

Mapping of COs with PSOs

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO 1	3	3	1	2	2	2	2	1	1	1	3	1
CO 2	3	2	1	2	2	3	3	1	1	1	3	1
CO 3	3	3	1	2	2	2	3	1	1	1	3	1
CO 4	3	3	1	2	2	2	1	1	1	1	3	1
CO 5	3	3	3	1	2	2	2	2	2	1	3	1

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	2	1	2
CO2	3	3	1	2
CO3	3	2	1	2
CO4	3	2	2	2
CO5	3	3	3	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**

 Weakly Correlated -**1**

COURSE DESIGNER:

Dr. N. Nagarani

Forwarded By

HOD'S Signature& Name

I M. Sc.

SEMESTER –II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG1ZAE	**Sericulture**	**Lecture**	**2**	**2**

COURSE DESCRIPTION

This course provides the knowledge of rearing of silkworm to produce raw silk.

COURSE OBJECTIVES

- Students should know basic concepts and techniques in Sericulture.
- Motivate young minds to become an entrepreneur for practicing
- sericulture as cottage industry.
- Gain knowledge about the diseases that affect silkworms.
- Know the steps involved in rearing and reeling process.

UNITS:

UNIT – I **(6 HRS.)**

Introduction to textile fibers; types- natural and synthetic fibers; sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber. History, development, status, characteristics and advantages of sericulture in India.Self –study - Binomial Nomenclature

UNIT – **(6 HRS.)**

Host plants; Moriculture- distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance-irrigation, manuring and pruning, pests and diseases of mulberry.Self –study - General characters of Protozoa

UNIT - III **(6 HRS.)**

Bombyx mori- morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races.Diapause.Egg-storage and transportation.

UNIT - IV **(6 HRS.)**

Rearing houses and equipment.Rearing operations- disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods- chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing. Diseases of *Bombyx mori*- protozoan, bacterial, viral and fungal. Pests of silkworm- Uzi fly, desmestids, mites, ants, nematodes, aves and mammals.

UNIT – V **(6 HRS.)**

Physical and commercial characteristics of cocoons.Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling. Weaving.By-products of sericulture industry.

TEXT BOOKS:

1. G. Ganga and J. Sulochana Chetty. 2019. An introduction to sericulture, 2nd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. M. Johnson and M. Kesary. 2019. Sericulture, Saras publication, Tamilnadu.
2. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.
3. M. Madan Mohan Rao. An Introduction to Sericulture, 2nd edition, BS Publications.

DIGITAL OPEN EDUCATIONAL RESOURCES

1. https://agritech.tnau.ac.in/sericulture/
2. https://csb.gov.in/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7904692/
4. CBCS Curriculum for B.Sc Zoology 242
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3115026/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids

UNIT -1				
1.1	Introduction to textile fibers; types- natural and synthetic fibers.	1	Chalk & Talk	Black Board
1.2	sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel	2	Chalk & Talk	Black Board
1.3	properties and importance of silk fiber	1	Lecture	PPT &White Board
1.4	History, development, status of sericulture in India	1	Lecture	PPT & White board
1.5	characteristics and advantages of sericulture in India	1	Chalk & Talk	Black Board
UNIT -2				
2.1	Host plants; Moriculture-distribution, morphology	1	Chalk & Talk	Green Board
2.2	propagation- seedling, cutting, grafting, layering and micropropagation methods	2	Chalk & Talk	Black Board
2.3	maintenance- irrigation, manuring and pruning	2	Chalk & Talk	Black Board
2.4	pests and diseases of mulberry	2	Chalk & Talk	Black Board

UNIT -3				
3.1	*Bombyx mori*- morphology, anatomy, life cycle	2	Lecture	PPT
3.2	geographical locations, larval moults, voltinism, indigenous and commercial races.	2	Lecture	PPT & White board
3.3	Diapause. Egg-storage and transportation	2	Lecture	LCD
UNIT -4				
4.1	Rearing houses and equipment. Rearing operations- disinfection, brushing, feeding and spacing..	2	Chalk & Talk	Black Board
4.2	Moulting and spinning. Harvest. Rearing methods- chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing.	1	Lecture	LCD
4.3	Diseases of *Bombyx mori*- protozoan, bacterial, viral and fungal.	2	Discussion	Google classroom
4.4	Pests of silkworm- Uzi fly, desmestids, mites, ants, nematodes, aves and mammals	1	Lecture	LCD

5.1	Physical and commercial characteristics of cocoons.	2	Chalk & Talk	Black Board
5.2	Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling.	2	Chalk & Talk	Black Board
5.3	Weaving. By-products of sericulture industry.	2	Chalk & Talk	Black Board

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Summarize the history, scope, source, types, importance and advantage of silk fibre in India.	**K1, K2 & K3**	**PSO1**
CO 2	Explain the distribution, morphology, cultivation techniques and disease of Mulberry plant.	**K3, K4 & K5**	**PSO1, PSO3 & PSO4**
CO 3	Analyse the morphology, anatomy, life cycle of *Bombyx mori*	**K5**	**PSO1, PSO3 & PSO4**
CO 4	Explain the methods of rearing process.	**K4**	**PSO1, PSO3 & PSO4**

CO 5	Identify and explain the Cocoon harvesting and marketing.	**K3**	**PS01, PSO4**

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	2	2	2	2	2	2	2	2	2	2
CO2	3	2	3	3	2	2	2	2	2	2	2	2
CO3	3	2	3	3	2	2	2	2	2	2	2	2
CO4	3	2	3	3	2	2	2	2	2	2	2	2
CO5	3	2	2	3	2	2	2	2	2	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	2	2	2
CO2	3	2	2	2
CO3	3	2	2	2
CO4	3	2	2	2
CO5	3	2	2	2

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:Forwarded By

HOD'S Signature
& Name

I M.Sc. Zoology

SEMESTER – II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG2Z4	Cellular and Molecular Biology	Theory	6	5

COURSE DESCRIPTION

This course deals with the central dogma of molecular biology and to understand the basis of heredity.

COURSE OBJECTIVES

- Understand the general concepts of cell and molecular biology.
- Understand the general concepts of cell and molecular biology. cellular structures influencing functional features.
- Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.
- Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.

UNITS

Unit IGeneral features of the cell (15 Hrs.)

Basic structure of prokaryotic and eukaryotic cells - Protoplasm and deutroplasm - cell organelles; cell theory; Diversity of cell size and shapes.

Unit IICellular organization (15 Hrs.)

Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts.

Unit IIICell division and Cell cycle (15 Hrs.)

Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription and translation in pro- and eukaryotic cells; Genetic maps

Unit IV Cell communication and cell signalling (15 Hrs.)

Membrane- associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.

Unit VCancer cells (15 Hrs.)

Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.

REFERENCES:

Text Books

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. Lewin's Cells (Third Edition), Jones & Bartlett, New Delhi, pp-1056
2. Plopper, G. 2013. Principles of Cell Biology, Jones & Bartlett, Maryland, pp-510

References Books

1. Karp, G. 2010. Cell Biology (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al.*, 2013. Molecular Cell Biology (Seventh Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 1987. Cell and Molecular Biology. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al.*, 1991, Cell Structure and Function (Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al.*, 1987, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319
8. Alberts, B., A. Johnson, J. Lewis, *et al.*, 2015, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342

9. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784
10.Tropp, B. 2008. Molecular Biology Genes to Proteins (Third Edition), Jones & Bartlett, US, pp-1000

Web Resources

DIGITAL OPEN EDUCATIONAL RESOURCES

6. https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology
7. https://www.cellmolbiol.org/
8. https://uwm.edu/biology/research/cell-and-molecular-biology/
9. https://www.omicsonline.org/cellular-and-molecular-biology.php
10. https://www.ccmb.res.in/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1				
1.	Basic structure of prokaryotic and eukaryotic cells -	5	Chalk&Talk, PPT	White Board, Black Board, LCD projector
2.	Protoplasm and deutroplasm - cell organelles; cell theory; Diversity of cell size and	5	Chalk&Talk, PPT	Green Board, Black Board, LCD projector
3.	Diversity of cell size and shapes.	5	Chalk&Talk, PPT	Smart Board

UNIT II				
4.	Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane	3	Chalk&Talk, PPT	Green Board, Black Board, LCD projector
5.	proteins diffusion, osmosis, ion channels, active transport, ion pumps,	4	Chalk&Talk, PPT	Smart Board, Green Board
6.	mechanism and regulation of intracellular transport, electrical properties of membranes.	4	Chalk&Talk, PPT	Smart Board, Green Board
7.	Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts.	4	Chalk&Talk, PPT	Smart Board, Green Board, Biovisual Charts
UNIT III				
8.	Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle.	3	Chalk&Talk, PPT	Green Board, Black Board, LCD projector
9.	Molecular biology of cell: Structure of DNA and RNA;	4	Chalk&Talk, PPT	Smart Board,

				Green Board
10.	Process of DNA replication, transcription and translation in pro- and eukaryotic cells;	4	Chalk&Talk, PPT	Smart Board, Green Board
11.	Genetic maps	4	Chalk&Talk, PPT	Smart Board, Green Board, Biovisual Charts
UNIT IV				
12.	Membrane- associated receptors for peptide and steroid hormones -	5	Chalk&Talk, PPT	Green Board, Black Board, LCD projector
13.	signaling through G-protein coupled receptors, signal transduction pathways.	5	Chalk&Talk, PPT	Smart Board, Green Board
14.	General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.	5	Chalk&Talk, PPT	Smart Board, Green Board
UNIT V				
15.	Characteristic features of normal and cancer cells;.	5	Chalk&Talk, PPT	Green Board, Black

				Board, LCD projector
16,	Carcinogens: types and cancer induction; Metastasis;	5	Chalk&Talk, PPT	Smart Board, Green Board
	Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth	5	Chalk&Talk, PPT	Smart Board, Green Board

Components	**Marks**	**Converted Marks**
T1	**30**	**15**
T2	**30**	
Assignment		**3**
Quiz / Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Understand the general concepts of cell and molecular biology.	K2	PO1
CO 2	Understand the general concepts of cell and molecular biology. cellular structures influencing functional features.	**K1& K2**	PO1, PO2
CO 3	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	**K3 & K4**	PO4, PO6
CO 4	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	**K5**	PO4, PO5, PO6
CO 5	Understand the general concepts of cell and molecular biology.	**K2**	PO3, PO8

Mapping COs Consistency with PSOs

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	**S**							
CO2	**M**	**S**						
CO3				**S**		**S**		
CO4				**S**	**S**	**M**		
CO5			**S**					**S**

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping of COs with POs

CO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	L	L	L	L	S	S	S	M	M	M
CO 2	M	M	M	S	S	S	S	M	S	M
CO 3	S	S	S	M	M	S	M	M	L	S
CO 4	M	M	S	L	S	S	L	M	S	S
CO 5	S	M	M	S	S	S	S	M	S	S

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2** ♦ Weakly Correlated -**1**

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SEMESTER – II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG2Z5	Developmental Biology	Theory	6	5

COURSE DESCRIPTION

This Course focuses on the developmental process from a single egg tozygote by fertilization, into blastula by Cleavage, followed by Gastrulationinto Gastrula. From Gastrula, organ forming rudiments are formed, whichgive rise to the Organ Systems of the Organism.

COURSE OBJECTIVES

Imparts knowledge on the developmental process from a single egg to foetus,then in an adult.

UNITS

Unit I

Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, permatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians.

Unit II

Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion in mammals, Acrosome reaction. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release - Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation - Parthenogenesis

Unit III

Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition - Determinate and regulatory embryos,

Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Sea urchin, Amphioxus, Amphibians, Aves, Mammals); Fate maps - (Amphibian and Chick), Epigenesis and preformation – Formation of primary germ layers.

Unit IV

Embryonic Development; Embryonic development of fish and birds, formation of extra embryonic membranes in mammalian – Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives. Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation. Gene and development; Anterior- posterior axis in determination in drosophila, Maternal effect genes - Bicoid and Nanos proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes.

Unit V

Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups, Factors stimulating regeneration – Biochemical changes assosciated with regeneration. Aging and senescences: Biology of senescences- cause of aging-mechanism involved in apoptosis. Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation

REFERENCES:

1.Balinsky,B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2.Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.

3.Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4.Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5.Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
7. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
8. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

Web Resources
DIGITAL OPEN EDUCATIONAL RESOURCES

1. www.easybiologyclass.com › developmental-biology-e
2. www.studocu.com › document › lecture-notes › view
3. ocw.mit.edu › courses › 7-22-developmental-biology-f.

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1				
1.1	Chief events in animal development	2	Lecture	Black Board
1.2	History of thoughts and conceptual developments.	3	Lecture	Black Board
1.3	Gametogenesis: Origin of germ cells, Spermatogenesis - Sperm morphology in relation to the type of fertilization	4	Chalk & Talk	Black Board
1.4	Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates	4	Lecture	LCD
1.5	Genetic control of vitellogenin synthesis in amphibians.	2	Lecture	Black Board
UNIT -2 Fertilization				

2.1	Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion in mammals	2	Lecture	LCD
2.2	Acrosome reaction. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release	2	Chalk & Talk	Black Board
2.3	Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei	2	Lecture	LCD
2.4	Post fertilization metabolic activation	2	Lecture	LCD
2.5	Parthenogenesis	2	Lecture	LCD
UNIT -3 Cleavage and gastrulation				
2.1	Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition	4	Chalk & Talk	Black Board
3.2	Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Sea urchin, Amphioxus, Amphibians, Aves, Mammals)	5	Lecture	LCD
3.3	Fate maps in Amphibian and Chick	3	Lecture	LCD
3.4	Epigenesis and preformation – Formation of primary germ layers	3	Lecture	LCD
UNIT -4 Embryonic Development				
4.1	Embryonic development of fish and birds, formation of	3	Lecture	LCD

	extra embryonic membranes in mammalian			
4.2	Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives.	2	Lecture	LCD
4.3	Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation.	4	Lecture	LCD
4.4	Gene and development; Anterior- posterior axis in determination in drosophila	2	Lecture	LCD
4.5	Maternal effect genes - Bicoid and Nanos proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes.	4	Lecture	LCD
UNIT -5 Post embryonic development				
5.1	**Metamorphosis:** Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis.	3	Lecture	LCD

5.2	**Regeneration:** Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups, Factors stimulating Regeneration – Biochemical changes assosciated with regeneration.	4	Lecture	LCD
5.3	Aging and senescences: Biology of senescences- cause of aging- mechanism involved in apoptosis.	2	Lecture	LCD
5.4	Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy.	3	Lecture	LCD
5.5	Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation	3	Lecture	LCD

Components	Marks	Converted Marks
T1	**30**	**15**
T2	**30**	
Assignment		**3**

Quiz / Seminar		**5**
Attendance		**2**
Total		**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Define the concepts of embryonic development	K1	PO1
CO 2	Observe various stages of cell divisions under microscope	K2 & K3	PO1, PO2
CO 3	Understand the formation of zygote	K4	PO4, PO6
CO 4	Differentiate the blastula and gastrula stages	K4 & K5	PO4, PO5, PO6
CO 5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	K4	PO3, PO8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	**S**							
CO2	**M**	**S**						

CO3				**S**		**S**		
CO4				**S**	**S**	**M**		
CO5			**S**					**S**

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	S	M	M	M
CO2	S	M	M	M
CO3	S	M	M	M
CO4	S	M	M	M
CO5	S	M	M	M

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2**
♦ Weakly Correlated -**1**

COURSE DESIGNER:

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SEMESTER – II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG2Z6	Lab Course in Cell Biology and	Practical	6	4

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
		Developmental Biology			

COURSE DESCRIPTION

It includes cell biology experiments such as observation of mitotic stages in onion root tip and visualizing giant chromosome in *Chironomus*larva and isolation and estimation of DNA and RNA.

COURSE OBJECTIVES

- Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.
- Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.
- Develop handling - skills through the wet-lab course.
- Learn the method of culturing of Drosophila and identification of their wild and mutant strains
- Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities

CELL AND MOLECULAR BIOLOGY

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Identification of various stages of meiosis in the testes of grasshopper
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
5. Detection of sex chromatin
6. Identification of blood cells in the haemolymph of the of the cockroach
7. Isolation of genomic DNA from eukaryotic tissue
8. Isolation of total RNA from bacterial cells/tissues
9. Agarose gel electrophoresis of DNA
10. SDS-Polyacrylamide gel electrophoresis

DEVELOPMENTAL BIOLOGY

Gametogenesis - Observation of gametes from gonadal tissue sections

i. Oogenesis:

- ✓ Section through ovary of shrimp, fish, frog and mammals

ii Spermatogenesis:

- ✓ Section through testis of shrimp, fish, calotes and mammals

Fertilization

iii Induced spawning in polycheate worm *Hydroids elegans*

iv *In vitro* fertilization and development in a polycheate worm *Hydroids elegans*

v Observation of egg developmental stages in *Emerita emeritus*

Embryogenesis

vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development

vii Chick embryonic stage - 24 hours of development

viii Chick embryonic stage - 48 hours of development

ix Chick embryonic stage - 72 hours of development

x Chick embryonic stage - 96 hours of development

Histological observation: Section through various developmental stages in chick embryo

Experimental Embryology

Regeneration in Frog Tadpoles

xi Blastema formation

xii Demonstration of regenerative process in tadpoleMetamorphosis

xiii Demonstration of metamorphosis in Frog Tadpole using exogenous IodineCryopreservation

xiv Demonstration of cryopreservation of gametes of fin fish/shell fish

REFERENCES:

1. Rajan S., Christy, S.R., (2011). *Experimental procedures in Life Sciences*, Anjana Book House, Chennai.
2. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015). *Advanced Practical Zoology*, Books and Allied (P) Ltd., Calcutta.
3. Sambrook and Russel, (2001). *Molecular Cloning Laboratory Manual*, 3rd ed., Cold Spring Harbor Laboratory Press, New York.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.nature.com/articles/205313a0
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5361071/
3. https://www.oercommons.org/courses/imaging-dna-structure
4. https://www.ncbi.nlm.nih.gov/books/NBK26936/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1660553/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 Experiments				
1.1	Determination of cell size using micrometer	4	Lecture & Demonstration	Blackboard & Specimen
1.2	Mitosis in root meristematic cells of plants	4	Demonstration	Specimen
1.3	Identification of various stages of meiosis in the testes of grasshopper	4	Demonstration	Specimen
1.4	Detection of polytene chromosome in salivary	4	Demo	Specimen

	gland cells of the larvae of the Chironomus			
1.5	Detection of sex chromatin	4	Demo	Specimen
1.6	Identification of blood cells in the haemolymph of the of the cockroach	4	Demo	Specimen
1.7	Isolation of genomic DNA from eukaryotic tissue	4	Hands on training	Tissue sample
1.8	Isolation of total RNA from bacterial cells/tissues	4	Hands on training	Calf Thymus DNA
1.9	Agarose gel electrophoresis of DNA	6	Hands on training	AGE
1.10	SDS-Polyacrylamide gel electrophoresis	6	Hands on training	SDS PAGE
DEVELOPMENTAL BIOLOGY				
2.1	i. Oogenesis: Section through ovary of shrimp, fish, frog and mammals.	5	Observation	Models, Microscope
2.2	Spermatogenesis: Section through testis of shrimp, fish, calotes and mammals	4	Observation	Models, Microscope

2.3	Induced spawning in polycheate worm *Hydroids elegans*	4	Observation	Models, Microscope
2.4	*In vitro* fertilization and development in a polycheate worm *Hydroids elegans*	4	Observation	Models, Microscope
2.5	Observation of egg developmental stages in *Emerita emeritus*	4	Observation	Models, Microscope
2.6	Observation and whole mount preparation of the chick blastoderm - 18 hours of development Chick embryonic stage - 24hours of development Chick embryonic stage - 48hours of development Chick embryonic stage - 72hours of development Chick embryonic stage - 96hours of development	6	Observation	Models, Microscope Specimens
2.7	Blastema formation	4	Observation	Models, Microscope Specimens
2.8	Demonstration of regenerative process in tadpoleMetamorphosis	4	Observation	Models, Microscope Specimens
2.9	Demonstration of metamorphosis in Frog Tadpole using exogenous IodineCryopreservation	6	Observation	Models, Microscope Specimens
2.10	Demonstration of cryopreservation of gametes of fin fish/shell fish	6	Observation	Models, Microscope Specimens

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Identify various stages in mitosis and meiosis.	**K3**	PO1
CO 2	Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus	**K3**	PO1, PO2
CO 3	Organize the steps in isolation of genomic DNA and RNA	**K3**	PO3, PO4, PO5
CO 4	Analyse the steps and principles involved in Agarose gel electrophoresis and SDS-Polyacrylamide gel electrophoresis techniques.	**K4**	PO4, PO5, PO6
CO 5	Analyse the various developmental stages in Chick embryo	**K4**	PO1, PO2, PO3, PO8

Mapping with Programme Outcomes*

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

CO5	S	S	M	L	S	M	L	S	S	S

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	S	M	M	M
CO2	M	S	M	M
CO3	M	S	S	S
CO4	M	M	S	S
CO5	M	M	S	M

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

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SEMESTER – II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG2ZE5	Economic Entomology	Theory	4	3

COURSE DESCRIPTION

This course deals with the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.

COURSE OBJECTIVES

- To understand the structures and distinct features of invertebrate phyla.
- To understand and able to distinguish the characteristic features of each phylum
- To understand the economic importance of invertebrates
- To understand the interaction of invertebrates with the environment.
- To understand the evolutionary position of different groups of invertebrates

UNITS

Unit I

Overview of insects and insect taxonomy: Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.

Unit II

Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.

Unit III

Destructive insects: Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold

level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.

Unit IV

Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.

Unit V

Vector biology: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures

REFERENCES:

Text Books

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.
3. Ross. H.H. 1965. A Text Book of Entomology, John Wiley & Sons Inc., New York, pp-746.

References Books

1. Chapman, R.F., S.J. SimpsonandA.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards and R.G. Davies (Eds.) IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
6. Mani, M.S. 1982. General Entomology. Oxoford& IBH Publishing Co., pp-912.
7. Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

DIGITAL OPEN EDUCATIONAL RESOURCES

1. Vector- Definition, Features, Types, Examples, Applications, Limitations (microbenotes.com)
2. Vector Definition and Examples - Biology Online Dictionary
3. Beneficial Insects: Meet the Bugs That Will Help Your Garden (treehugger.com)
4. http://isca.in/AGRI_FORESTRY/Archive/v3/i5/5.ISCA-RJAFS-2015-012.pdf
5. https://oercommons.org/courses/beneficial-bug-scavenger-hunt

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 OVERVIEW OF INSECTS AND INSECT TAXONOMY				
1.1	Overview of insects and insect taxonomy:	1	Chalk and Talk	Black Board
1.2	Insects and their biological success -	2	Chalk and Talk	Black Board
1.3	Man and insects;.	3	Group Discussion	-
1.4	Basic concepts in Insect Taxonomy and classification	2	Lecture	PPT & White Board
UNIT -2 BENEFICIAL INSECTS				
2.1	Beneficial insects:Silkworms - types, life history, disease management and rearing methods -;	1	Chalk and Talk	Black Board

2.2	Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive	2	Lecture	PPT & White Board
2.3	Lac insects-life history, lac cultivation	3	Chalk and Talk	Black Board
2.4	Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.	2	Lecture	PPT & White Board
UNIT -3 DESTRUCTIVE INSECTS				
3.1	Destructive insects:Insect pests - definition - Categories of pests.	1	Chalk and Talk	Black Board
3.2	Types of damage to plants by insects - Causes of pest outbreak. Economic threshold level.	3	Chalk and Talk	Black Board
3.3	Biology of the insect pests - Pests of paddy, cotton, sugarcane	3	Lecture	PPT & White Board
3.4	Biology of the insect pests - Pests of vegetables, coconut and stored grains cereals	2	Chalk and Talk	Black Board
UNIT IV: PEST MANAGEMENT/CONTROL STRATEGIES				
4.1	Methods and principles of pest control - Natural control, Artificial control	4	Chalk and Talk	Black Board
4.2	Merits and demerits or limitations in methods of pest control	2	Group Discussion	-

4.3	Development and use of pest resistant plant varieties	3	Lecture	PPT & White Board
4.4	Integrated pest management - Concepts and practice.	3	Chalk and Talk	Black Board
UNIT V: VECTOR BIOLOGY				
5.1	Vector biology:Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures	3	Chalk and Talk	Black Board
5.2	Mosquitoes as potential vectors of human diseases-control measures	3	Lecture	PPT & White Board

Components	**Marks**	**Converted Marks**
T1	**30**	**15**
T2	**30**	
Assignment		**3**
Quiz / Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS

CIA	ESE	Total
25	75	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Understand taxonomy, classification and life of insects in the animal kingdom.	K1 & K2	PO1
CO 2	Know the life cycle, rearing and management of diseases of beneficial insects.	K2 & K3	PO1, PO2, PO3
CO 3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	K2 & K3	PO3, PO4, PO5
CO 4	Recognize insects which act as vectors causing diseases in animals and human.	K2 & K4	PO4, PO5, PO6
CO 5	Overall understanding on the importance of insects in human life.	K2 & K6	PO1, PO2, PO3, PO5

Mapping COs Consistency with PSOs

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	S							
CO2	M	S						
CO3			S	S	S	S		
CO4			S	S	S	M		
CO5			S					S

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO1 0**
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

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

COURSE DESIGNER:

Forwarded By

HOD'S Signature & Name

Elective Course Discipline Specific

I M.Sc., ZOOLOGY

SEMESTER –II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23P2ZE6	Microbiology	Lecture	4	3

COURSE DESCRIPTION

To understand the fundamentals of Microbial diversity and applications of microbes in Industry and Environment

COURSE OBJECTIVES

- To gain knowledge of microorganisms with particular emphasis on the nomenclature, classification and biology of bacteria, viruses, viriods and prions.
- To understand the microbial metabolism
- To provide an overview on the utilization and application of microbes in Industry.

UNITS

UNIT –I INTRODUCTION (12 HRS.)

History and Scope of Microbiology - Whittaker's Five Kingdom Concept - Classification according to Bergey's manual- Microscopy - Principle, Components and applications of Phase contrast microscope, Fluorescence microscope, Dark field Microscope and Electron microscope- SEM & TEM.

Self-study –History and Scope of Microbiology

UNIT –II BACTERIA (12 HRS.)

Morphological types - Cell shapes and arrangements - External cell structures - Pili, Flagella and Glycocalyx - Cell envelope - cell walls of Gram negative and Gram positive. Archaebacteria - Nuclear material – bacterial chromosomes and plasmids.Sterilization methods - Classification of Culture media - Growth Kinetics.

Self-study– Classification of Culture media (Simple, complex and special media with examples)

UNIT –III VIRUSES, VIRIODS & PRIONS (12 HRS.)

Brief outline on discovery of viruses, origin of viruses, Nomenclature and classification of viruses - ICTV system of classification, properties of viruses.Morphology and ultrastructure of viruses; viral genome (RNA, DNA); Structure and importance of Viriods, Prions.

Self-study– Nomenclature and classification of viruses

UNIT –IV MICROBIAL METABOLISM (12HRS.)

Nutritional Categories of microorganisms; Anaerobic Respiration; Photosynthesis in Cyanobacteria; cyclic and noncyclic photophosphorylation; fixation of CO_2 - Calvin cycle; Assimilation of inorganic phosphorus and sulfur – Nitrogen fixation – Symbiotic and asymbiotic relationship.

Self-study - Nitrogen fixation

UNIT –V APPLIED MICROBIOLOGY (12HRS.)

Food Microbiology - Food spoilage - Preservation - Fermented foods - Microorganisms as source of food - Industrial Microbiology - Fermentation: alcoholic fermentation - Production of Antibiotics - Penicillin; Bioinsecticides – *Bacillus thuringiensis* - Brief note on Biopolymers, Biosurfactants, Bioremediation and Biosensors.

Self-study– Food Microbiology - Food spoilage – Preservation - Bioinsecticides – *Bacillus thuringiensis* - bioremediation

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)

REFERENCES:

1. Presscott L.M, Harley J. P and Klein D. A., (1999) Microbiology, 4th ed., Mc-Graw Hill, United States.
2. Pommerville J. C., (2010). *Alcamo's Fundamentals of Microbiology*, 8th ed., Jones and Bartlett Publishers.

3. Ingraham J.L a23nd Ingraham C.A., (2005) *Microbiology- An Introduction*, India Binding House.
4. Ananthanarayanan R and Panicker C.K.J., (2005) *Textbook of Microbiology*, 7th ed., Orient Longman.
5. Tortora G.J., Funke B.R., Case C. L., (2005) *Microbiology*: *An Introduction, 8th Edition,* Benjamin Cummings.
6. Dubey R. C., and Maheswari D.K., (2004). *A Textbook of Microbiology, 6th ed.,* Chand and company Ltd.
7. Pelczar M.J., Chan E.C.S.,andKreig N.R.,(2001). *Microbiology*, *5th ed.,* Tata Mc Graw Hill, New Delhi.

DIGITAL OPEN EDUCATION RESOURCES (DOER):

1. https://openstax.org/details/books/microbiology
2. https://open.oregonstate.education/microbiology/front-matter/preface/
3. https://www.oercommons.org/courses/microbiology-4/view
4. http://www.oercommons.org/courses/textbook-of-bacteriology/view
5. https://www.oercommons.org/courses/kimball-s-biology-pages

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 INTRODUCTION				
1.1	History and Scope of Microbiology	2	Discussion	Black Board
1.2	Whittaker's Five Kingdom Concept -Protist, Fungi, Helminthes	2	Chalk &Talk	Black Board
1.3	Classification according to Bergey's manual	3	Chalk & Talk	LCD

1.4	Microscopy - Principle, Components and applications of Phase contrast microscope.	2	Lecture	PPT & White board
1.5	Fluorescence microscope	1	Lecture	Black Board
1.6	Dark field Microscope.	1	Lecture	PPT
1.7	Electron microscope- SEM &TEM	1	Discussion	Google classroom
UNIT -2 BACTERIA				
2.1	Morphological types	1	Chalk & Talk	Black Board
2.2	Cell shapes and arrangements - External cell structures - Pili, Flagella and Glycocalyx	3	Chalk & Talk	LCD
2.3	Cell envelope - cell walls of Gram negative, Gram positive & Archaebacteria	3	Lecture	PPT & White board
2.4	Nuclear material – bacterial chromosomes and plasmids.	1	Lecture	Black Board
2.5	Sterilization methods	1	Chalk & Talk	LCD
2.6	Classification of Culture media	1	Discussion	Black Board
2.7	Growth Kinetics	2	Lecture	Black Board
UNIT -3 VIRUSES, VIRIODS & PRIONS				
3.1	Brief outline on discovery of viruses, origin of viruses	1	Chalk &Talk	Black Board
3.2	Nomenclature and classification of viruses	2	Discussion	Black Board
3.3	Properties of viruses.	2	Chalk & Talk	LCD
3.4	Morphology and ultra-structure of viruses	3	Lecture	PPT & White board

3.5	Capsids and their arrangements; types of envelopes and their composition.	3	Lecture	Black Board
3.6	Viral genome (RNA, DNA)	2	Lecture	LCD
3.7	Structure and importance - Viriods, Prions,	2	Discussio n	Google classroom
UNIT -4 MICROBIAL METABOLISM				
4.1	Nutritional categories of Microorganisms	1	Chalk & Talk	Black Board
4.2	Anaerobic Respiration	2	Chalk & Talk	LCD
4.3	Photosynthesis in Cyanobacteria	1	Lecture	PPT & White board
4.4	Cyclic and noncyclic photophosphorylation	2	Lecture	Black Board
4.5	Fixation of CO_2 - Calvin cycle	2	Lecture	PPT
4.6	Assimilation of inorganic phosphorus and sulphur	2	Discussio n	Google classroom
4.7	Nitrogen fixation. – Symbiotic and asymbiotic relationship.	2	Discussio n	Black Board
UNIT -5 APPLIED MICROBIOLOGY				
5.1	Food Microbiology - Food spoilage - Preservation	1	Discussio n	Black Board
5.2	Fermented foods - Microorganisms as source of food	1	Chalk & Talk	Black Board
5.3	Industrial Microbiology Fermentation: Alcoholic fermentation	2	Chalk & Talk	LCD
5.4	Production of Antibiotics - Penicillin	2	Lecture	PPT & White board

5.5	Bioinsecticides – *Bacillus thuringiensis*	1	Lecture	LCD
5.6	Biopolymers	1	Lecture	Black Board
5.7	Biosurfactants	2	Discussion	Google classroom
5.8	Bioremediation	1	Lecture	Black Board
5.8	Biosensors	1	Discussion	LCD

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Describe the scope of microbiology, taxonomical classification, principle and components of different types of microscopes	**K3**	PSO1, PSO2, PSO5
CO 2	Classify bacteria based on morphology, biochemical characteristics and growth parameters	**K4**	PSO1, PSO2, PSO11
CO 3	Discuss the morphology and classification of viruses.	**K3**	PSO1, PSO4 PS05
CO 4	Explain the metabolism of bacteria	**K2**	PSO1, PS09
CO 5	Appraise the role of bacteria in food, industry, medicine, environment and agricultural microbiology	**K5**	PSO1, PS05, PSO6, PSO9

Mapping of COs with PSOs

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO 10	PSO 11	PSO 12
CO 1	3	3	2	2	3	2	2	2	2	2	2	2
CO 2	3	3	3	2	2	2	2	2	2	2	3	2
CO 3	3	3	2	2	3	2	2	2	2	2	2	2
CO 4	3	3	2	2	2	2	2	2	3	2	2	2
CO 5	3	2	2	2	3	3	2	2	3	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	3	2	2
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	2	2	2
CO5	3	3	2	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**
 Weakly Correlated -**1**

COURSE DESIGNER:

Dr. Sr. BijiCyriac

Forwarded By

HOD'S Signature
& Name

I M.Sc. Zoology

SEMESTER – II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG2ZE7	Research Methodology	Theory	4	3

COURSE DESCRIPTION

This course imparts the basic principle, methodology and applications of widely used instruments in biological sciences.

COURSE OBJECTIVES

- To understand the implications of GLP
- To learn the working principles of different instruments
- To gain the knowledge on techniques of histology and histochemistry
- To acquire knowledge on the basic principle and application of various modules of light and electron microscopy

- To appreciate the applications of tracer techniques and animal cell culture techniques

UNITS

UNIT –I INTRODUCTION TO GLP &BIOINSTRUMENTATION (12 HRS.)

Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry.

UNIT – II HISTOLOGY (12 HRS)

Histology, Histochemistry, Bioinformatics and Electron microscopy.

UNIT – IIIMICROSCOPY (12 HRS)

Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.

UNIT – IVBIOLOGICAL TECHNIQUES (12 HRS)

Centrifuges, Chromatography, Electrophoresis, ELISA and blotting.

UNIT – V ANIMAL CELL CULTURE (12 HRS)

Principles and Applications of tracer techniques in biology, Animal cell culture techniques.

REFERENCES:

1. Wilson K and Walker J., (2013) *Principles and Techniques of Biochemistry and Molecular Biology, 7th ed.,* Cambridge University Press, New York.
2. Roe S., (2001) *Protein Purification Techniques – A Practical Approach, 2nd* ed., Oxford University Press.
3. Boyer R., (2000) *Modern Experimental Biochemistry, 3rd ed.,* Pearson Education Inc.
4. Wilson K and Kenneth H.G., (1992) *A Biologists Guide to Principles and Techniques of Practical Biochemistry, 3rd ed.*, Cambridge University Press, Cambridge, UK.
5. Satyanarayana U., and ChakrapaniU.(2014)*Biochemistry, 4th Revised ed,* Reprinted. Elsevier, Reed Elsevier India Private Limited, New Delhi and Books and Allied (P) Ltd., Kolkata.

6. Rastogi S.C. (2006) *Biochemistry, 2nded, 5th Reprint.* Tata McGraw-Hill Publishing Company Limited, New Delhi).
7. Lehninger L.A., Nelson D.L and Cox M.M. (2005) *Principles of Biochemistry, 5th ed.*, W.H.Freeman and Company, New York.
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9. Stryer L (2003) *Biochemistry, 5th ed.*, W.H.Freeman Publishers, New York.
10. Murray K.R., Granner D.K., Mayer A.P and RodwellV.W.(2000)*Harper's Biochemistry, 25th ed.*, Appleton and Lange.
11. Devlin M.T.(1997) *Textbook of Biochemistry with Clinical Correlations,* Wiley-Liss Pub, New York.
12. Montgomery R., Conway T.W., Spector A.A and Chapell D. (1996) *Biochemistry – A case oriented approach, 6th ed.,* Mosby Inc., London.
13. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
14. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.
15. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.
16. Chandler, D.E. and Roberson R.W. 2009. Bioimaging: Current Concepts in Light and Electron Microscopy, Jones and Bartlet Publishers, Sudbury, MA, USA, pp440.
17. Engelbert, B. 1960. Radioactive Isotopes in Biochemistry, Elsevier Applied Science, pp-376.
18. Wolf, G. 1964. Isotopes in Biology, Academic Press, pp-173.
19. Srivastava, B. B. 2005. Fundamentals of Nuclear Physics, Rastogi Publications, pp-500.

Web Resources

DIGITAL OPEN EDUCATIONAL RESOURCES

1. http://amrita.olabs.edu.in/?sub=73&brch=8&sim=209&cnt=1
2. https://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/organic-materials/31-protein-structure/
3. https://openlab.citytech.cuny.edu/bio-oer/chemistry/biologically-important-macromolecules/proteins/protein-detection/
4. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=236&cnt=1
5. http://amrita.olabs.edu.in/?sub=79&brch=17&sim=205&cnt=1

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 INTRODUCTION TO GLP & BIOINSTRUMENTATION				
1.1	Good laboratory practice (GLP)	5	Chalk & Talk	Black Board
1.2	pH, Electrodes and pH meter	3	Lecture	PPT
1.3	Colorimeter and Spectrophotometry.	4	Chalk & Talk	Green Board
UNIT -2 HISTOLOGY				
2.1	Histology	1	Lecture	Green Board
2.2	Histochemistry	3	Chalk & Talk	Green Board
2.3	Bioinformatics	4	Lecture	Smart Board
2.4	Electron microscopy	4	Lecture	Board
UNIT -3 MICROSCOPY				
3.1	Light Microscopy	1	Chalk & Talk	Black Board
3.2	Bright field, Phase contrast Microscopy	4	Lecture	LCD
3.3	DIC & Fluorescence microscopy,	4	Lecture	LCD

3.4	wide field and Confocal microscopy.	4	Lecture	LCD
UNIT -4 BIOLOGICAL TECHNIQUES				
4.1	Centrifuges	1	Chalk & Talk	Black Board
4.2	Chromatography	3	Chalk & Talk	Black Board
4.3	Electrophoresis	3	Chalk & Talk	Black Board
4.4	ELISA	2	Chalk & Talk	Black Board
4.5	Blotting techniques	3	Chalk & Talk	Black Board
UNIT - 5 ANIMAL CELL CULTURE				
5.1	Principles and Applications of tracer techniques in biology,	5	Chalk & Talk	Black Board
5.2	Principles and Applications of Animal cell culture techniques.	7	Lecture	Green Board

Components	**Marks**	**Converted Marks**
T1	**30**	**15**
T2	**30**	
Assignment		**3**
Quiz / Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To understand the implications of GLP	**K1**	PO1
CO 2	To learn the working principles of different instruments	**K2**	PO1, PO2
CO 3	To gain the knowledge on techniques of histology and histochemistry	**K2 & K4**	PO4, PO6
CO 4	To acquire knowledge on the basic principle and application of various modules of light and electron microscopy	**K3 & K5**	PO4, PO5, PO6
CO 5	To analyse the applications of tracer teachniques and animal cell culture techniques	**K3 & K5**	PO3, PO8

Mapping COs Consistency with PSOs

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	**S**							
CO2	**M**	**S**						
CO3				**S**		**S**		
CO4				**S**	**S**	**M**		
CO5			**S**					**S**

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	2	3	2	2
CO2	2	3	2	2
CO3	2	3	2	2
CO4	2	3	2	2
CO5	2	3	2	2

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2** ♦ Weakly Correlated -**1**

COURSE DESIGNER:

Forwarded By

HOD'S Signature & Name

Elective Course - Discipline Specific

I M.Sc., ZOOLOGY

SEMESTER –II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	23PG2ZE8	Biophysics	Lecture	4	3

COURSE DESCRIPTION

Biophysics which is an inter disciplinary course, deals with the discipline concerned with the application of the principles and methods of physics and the other physical sciences to the solution of biological problems.

COURSE OBJECTIVES

- To imbibe the principles of physics involved in the structure elucidation of biomolecules
- To understand the principles of energy transformation in living systems
- To apply the use of modern physical instruments to unravel the importance of therapeutic radiology, in which the measurement of dose is critical to treatment, and in diagnostic radiology, particularly with techniques involving isotopes

UNITS:

UNIT-I: CHEMCAL BONDS AND MOLECULAR INTERACTIONS [12 HRS.]

Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide bond, Peptide bonds- Forces between Molecules: Electrostatic force, Van der Waal's forces, hydrophobic and hydrophilic - Biological importance and domains of Physics in Biology-Electrolytic dissociation and electrolytes:- Ionisation, Basis of acidity and Basicity, Bronsted Lowry theory, strength of acids and bases, Henderson and Hasselbalch equation. Water as Dipole -Biological importance of water

Self-Study:-Water as Dipole -Biological importance of water

UNIT-II: THERMODYNAMICS AND BIOLOGICAL OXIDATION [12 HRS.

Laws of Thermodynamics: Concept of free energy and entropy, Exergonic and Endergonic reactions; Diffusion: Fick's Laws-I & II law, constant laws, Osmotic coefficient: Gibbs Donnan equilibrium- Oxidation and reduction reactions: Redox potentials in biological system- High energy phosphate group: ATP synthesis in mitochondria.

UNIT-III: INSTRUMENTATION [12 HRS.]

Principle, Components and Biological applications of Polarising microscope, Inverted microscope, Confocal and X-ray microscope, Flow cytometry. Spectrophotometry: Laws of absorption, complementary colours, Chromophore concept, Absorption spectrum, Wavelength selectors, Detection devices, amplification and read out. Chromatography: Paper chromatography, TLC and Column chromatography. Centrifugation: Principle, Types & Applications, Relative Centrifugal Force, Factors affecting sedimentation and types of centrifugation.

Self-Study: Principle, Components and Biological applications of Light microscope

UNIT-IV: PHOTO BIOPHYSICS [12 HRS.]

Electromagnetic spectrum: Components of EMR, Quantum theory of radiation, Biological application, Effects of UV on Biological systems - Radioactive isotopes: Measurements of radiation, Dosimetry, Cerenkov radiation, Gas ionization methods: Ionization chambers, proportional counters, GM tubes, Photographic methods: Autoradiography - Excitation method: Liquid Scintillation counters; Use of isotopes as tracers in Biology; Safety aspects.

Self-Study:-Use of isotopes as tracers in Biology; Safety aspects, Effects of UV on Biological systems

UNIT-V: BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY [12 HRS.]

Biophysical aspects of vision: photoreceptors: simple and compound, structure and function of vertebrate eye, mechanism of conversion of light: Biophysical aspects of hearing, noise and speech-mechanism of hearing-auditory and non-auditory effects of noise pollution; stimulation to neuronal impulse - Nerve conduction: Neurotransmitters and Synapse, Conduction of nerve impulse.

Self-Study:-Neurotransmitters and Synapse

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)

REFERENCES:

1. Claycomb J.J, Tran J.Q.P., (2011) *Introductory Biophysics: Perspectives on the living state, Jones and Bartlett publishers*, New Delhi.
2. Upadhyay A, Upadhyay K and Nath N., (2007) *Biophysical chemistry Principles and Techniques, Himalaya Publishing House Pvt.* Ltd., Mumbai.
3. Narayanan P, (2007) *Essentials of Biophysics, New Age International (P) Ltd.,* Publishers, New Delhi.

4. Nolting B., (2005) *Methods in modern Biophysics, Springer (India) private Ltd.,* New Delhi.
5. Cotterill R., (2004) *Biophysics and Introduction, John Wiley and Sons* Ltd., printed in India by Replika press pvt. Ltd., Kundli
6. Agarwal S.K., (2005) *Advanced Biophysics, APH publishing corporation,* New Delhi.
7. Pattabhi V and Gautham N., (2004) *Biophysics*, Narosa Publishing House, New Delhi.

DIGITAL OPEN EDUCATION RESOURCES (DOER):

1. http://oer.iain-padangsidimpuan.ac.id/items/show/98
2. https://www.oercommons.org/authoring/15047-basic-thermodynamics/view
3. https://www.oercommons.org/courseware/lesson/56957
4. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Fundamentals/Ionic_and_Covalent_Bonds
5. https://www.khanacademy.org/science/ap-biology/chemistry-of-life/introduction-to-biological-macromolecules/a/chemical-bonds-article

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 CHEMCAL BONDS AND MOLECULAR INTERACTIONS				
1.1	Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide bond, Peptide bonds-	2	Discussion	Black Board
1.2	Forces between Molecules: Electrostatic force, Van der	1	Chalk & Talk	LCD

	Waal's forces, hydrophobic and hydrophilic			
1.3	Biological importance and domains of Physics in Biology	1	Lecture	PPT & White board
1.4	Electrolytic dissociation and electrolytes:- Ionisation, Basis of acidity and Basicity,	1	Lecture	Smart Board
1.5	Bronsted Lowry theory, strength of acids and bases,	2	Lecture	Black Board
1.6	Henderson and Hasselbalch equation.	1	Chalk &Talk Discussio n	Google classroom
1.7	Water as Dipole -Biological importance of water	3	Lecture	Black Board
UNIT-2 THERMODYNAMICS AND BIOLOGICAL OXIDATION				
2.1	Laws of Thermodynamics: Concept of free energy	2	Lecture	Green Board Charts
2.2	Entropy, Exergonic and Endergonic reactions,	1	Chalk & Talk	Green Board
2.3	Rate of reactions - Effect of sunlight and temperature on reactions	2	Discussio n	Black Board
2.4	Energy of Activation: Arrhenius expression	1	Chalk & Talk	Green Board
2.5	Diffusion: Fick's Laws-I & II law,	2	Lecture	PPT & White board
2.6	constant laws, Osmotic coefficient	1	Lecture	Smart Board

2.7	Gibbs Donnan equilibrium-	1	Lecture	Black Board
2.8	Oxidation and reduction reactions: Redox potentials in biological system	1	Chalk & Talk Discussion	Google classroom
2.9	High energy phosphate group : ATP synthesis in mitochondria, ATP synthase.	1	Lecture	Black Board
UNIT-3 INSTRUMENTATION				
3.1	Principle, Components and Biological applications of Light microscope	1	Chalk &Talk	Black Board
3.2	Principle, Components and Biological applications of Polarising microscope	1	Chalk & Talk	LCD
3.3	Principle, Components and Biological applications of Inverted microscope	1	Lecture	PPT & White board
3.4	Principle, Components and Biological applications of Confocal microscope	1	Lecture	Smart Board
3.5	Principle, Components and Biological applications of X-ray microscope	1	Lecture	Black Board
3.6	Flow cytometry	1	Discussion	Google classroom
3.7	Colorimetry and Spectrophotometry: Laws of absorption, complementary colours	1	Lecture	Black Board
3.7	Chromophore concept, Absorption spectrum, Wavelength selectors, Detection	1	Lecture	Black Board

	devices, amplification and read out			
3.8	Chromatography: Paper chromatography	1	Lecture	Black Board
3.9	TLC	1	Lecture	PPT & White board
3.10	Column chromatography	1	Lecture	PPT & White board
3.11	Centrifugation: Principle, Types & Applications, Relative Centrifugal Force- Factors affecting sedimentation and types of centrifugation	1	Lecture	PPT &White board
UNIT-4 PHOTO BIOPHYSICS				
4.1	Electromagnetic spectrum: Components of EMR	1	Chalk &Talk	Black Board
4.2	Quantum theory of radiation	1	Chalk &Talk	LCD
4.3	Biological application	1	Lecture	PPT & White board
4.4	Effects of UV on Biological systems	1	Lecture	Smart Board
4.5	Radioactive isotopes: Measurements of radiation, Dosimetry	1	Lecture	Black Board
4.6	Cerenkov radiation and Interaction of radioactivity with matter	1	Discussio n	Google classroom

4.7	Gas ionization methods: Ionization chambers, proportional counters, GM tubes	2	Lecture	Black Board
4.7	Photographic methods: Autoradiography,	2	Lecture	Black Board
4.8	Excitation method: Liquid Scintillation counters	1	Lecture	Black Board
4.9	Use of isotopes as tracers in Biology; Safety aspects	1	Lecture	Black Board
UNIT-5 BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY				
5.1	Biophysical aspects of vision: photoreceptors: simple and compound	1	Chalk & Talk	Black Board
5.2	Structure and function of vertebrate eye,	1	Chalk & Talk	LCD
5.3	Mechanism of conversion of light stimulation to neuronal impulse	2	Lecture	PPT & White board
5.4	Biophysical aspects of hearing, noise and speech-mechanism of hearing-auditory and non-auditory effects of noise pollution	2	Lecture	Black Board
5.5	Nerve conduction: Neurotransmitters and Synapse	2	Lecture	Smart Board
5.6	Membrane potential, resting potential and action potential,	1	Lecture	Black Board
5.7	Action potentials in earthworm nerve fiber	2	Discussion	Google classroom
5.8	Muscle Contraction	2	Lecture	Black Board

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Classify the chemical bonds and forces interacting between molecules and Determine the theories involved in acidity and basicity	**K2**	PSO1& PSO2
CO 2	Apply the principles of Thermodynamics and biological oxidation in living organisms	**K3**	PSO2
CO 3	Determine the principle, procedure, components involved and biological applications of Instruments	**K3**	PSO1
CO 4	Analyse the principle, properties, instrumentation and biological applications of Electromagnetic radiation	**K4**	PSO4
CO 5	Assess the principles of Photobiology in the Biophysical aspects of Vision and neurophysiology applied to the Animals	**K5**	PSO1 & PSO2

Mapping of COs with PSOs

CO /	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12

PSO												
CO1	3	3	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	3	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	1	2	2	2	2	2	2	2	2
CO5	3	3	2	2	2	2	2	2	2	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	2	2	2
CO2	3	2	2	2
CO3	3	2	2	2
CO4	3	3	3	2
CO5	3	3	2	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**
 Weakly Correlated -**1**

COURSE DESIGNER:

1. **Dr.N.MALATHI**

Forwarded By

HOD'S Signature& Name

SEC -EDC

I M.Sc. Zoology

SEMESTER – II

For those who joined in 2023 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
PSZO	23PG2ZSE1	Poultry Farming	Theory	4	2

COURSE DESCRIPTION

The course has great potential for creating self-employment and businessopportunity

COURSE OBJECTIVES

● Enable the students to be familiarized with Poultry farming to become an entrepreneur.

● Know to manage and maintain Poultry farms.

UNITS

UNIT I (12 Hrs)

General introduction to Poultry farming - Definition of Poultry - Past and present scenario of Poultry industry in India - Principles of Poultry housing - Poultry houses - Systems of poultry farming

UNIT II (12 Hrs)

Management of Chicks - growers and layers - Management of Broilers. - Preparation of Project report for banking and insurance.

UNIT III (12 Hrs)

Poultry Feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.

UNIT IV **(12 Hrs)**

Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme..

UNIT V **(12 Hrs)**

Selection, care and handling of hatching eggs - Egg testing. Methods of hatching.- Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.

REFERENCES:

References Books

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

Web Resources

DIGITAL OPEN EDUCATIONAL RESOURCES

1. 2. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
2. 3.https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
3. 4. http://ecoursesonline.iasri.res.in/course/view.php?id=335
4. 5. https://swayam.gov.in/nd2_nou19_ag09/preview
5. https://www.nio.org/
6. https://greatbarrierreef.org/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 Introduction to Poultry Farming				
1.1	General introduction to poultry farming - Definition of Poultry - Past and present	6	Lecture	LCD

	scenario of poultry industry in India.			
1.2	Principles of poultry housing - Poultry houses - Systems of poultry farming	6	Lecture	LCD
UNIT -2				
2.1	Management of chicks - growers and layers - Management of Broilers. -	7	Lecture	LCD
2.2	Preparation of project report for banking and insurance.	5	Lecture	LCD
UNIT -3 Poultry feed management				
3.1	Principles of feeding, Nutrient requirements for different stages of layers and broilers	7	Lecture	LCD
3.2	Feed formulation and Methods of feeding.	5	Lecture	LCD
UNIT -4Poultry diseases				
4.1	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management	7	Lecture	LCD
4.2	Vaccination programme.	5	Lecture	LCD
UNIT -5				
5.1	Selection, care and handling of hatching eggs - Egg testing.	4	Lecture	LCD

5.2	Methods of hatching - Brooding and rearing -. Sexing of chicks.	4	Lecture	LCD
5.3	Farm and Water Hygiene - Recycling of poultry waste.	4	Lecture	LCD

Components	Marks	Converted Marks
T1	**30**	**15**
T2	**30**	
Assignment		**3**
Seminar		**5**
Attendance		**2**
	Total	**25 Marks**

EVALUATION PATTERN

MARKS		
CIA	**ESE**	**Total**
25	**75**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To understand the various practices in Poultry farming. To know the	K2 & K3	PO1

	needs for Poultry farming and the status of India in global market.		
CO 2	To be able to apply the techniques and practices needed or Poultry farming.	K1, K2 & K3	PO1, PO2
CO 3	To know the difficulties in Poultry farming and be able to propose plans against it.	K5 & K6	PO4, PO6
CO 4	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	K2 & K3	PO4, PO5, PO6
CO 5	To be able to apply the techniques and practices needed or Poultry farming.	K1, K2 & K3	PO3, PO8

Mapping COs Consistency with PSOs

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	**S**							
CO2	**M**	**S**						
CO3				**S**		**S**		
CO4				**S**	**S**	**M**		
CO5			**S**					**S**

S-Strong(3) M-Medium (2) L-Low (1) B N

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**S**	**M**	**M**	**M**
CO2	**S**	**M**	**M**	**M**
CO3	**S**	**M**	**M**	**M**

CO4	**S**	**M**	**M**	**M**
CO5	**S**	**M**	**M**	**M**

Note: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2**
♦ Weakly Correlated -**1**

COURSE DESIGNER:

Forwarded By

HOD'S Signature
& Name

I M.Sc., ZOOLOGY

SEMESTER –II

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS	CREDITS
PSZO	19PAD2CA	Computer Applications for Biologists	Lecture & Practical	40	4

COURSE DESCRIPTION

It provides hands on experience on the tools and techniques of bioinformatic sequence analysis. It begins with the data storage in major biological databases, retrieval of sequences and bioinformatics tools used for pairwise and multiple sequence alignment.

COURSE OBJECTIVES

To gain skills on *in silico* data analysis and protein structure prediction

COURSE CONTENT

1. Statistical analysis with MS-EXCEL
2. Biological databases – NCBI, UniProt
3. Sequence retrieval from biological databases
4. Sequence similarity analysis – BLAST, FastA,
5. Multiple sequence alignment - ClustalO
6. Phylogenetic analysis – MEGA6
7. Protein Structure visualization – PDB, Rasmol
8. Homology modeling - SWISSPDB Viewer

REFERENCES:

1. Khan I.A and Khanum A., (2004). *Fundamentals & Biostatistics*, 2nd ed., Ukaaz Publications, Hyderabad.
2. Banerjee P.K., (2006). *Introduction to Biostatistics*, 3rd ed., S.Chand Publication, New Delhi.
3. Misra B.N and Misra M.K., (1983). *Introduction to Practical Biostatistics*, NayaProkash, Calcutta.

4. Baxevanis D and Francis B.F., (2004). *Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins*, 3rd ed., John Wiley & Sons Inc.
5. Attwood T.K and Parrysmith D.J., (2005). *Introduction to Bioinformatics*, Pearson Education.
6. Campbell M.A and Heyer L.J., (2004). *Discovering Genomics*, Proteomics and Bioinformatics, Pearson Education.
7. Gibson G and Muse S.V., (2002). *A Primer of Genomic Science*, Sinauer Associates Inc. Pub., Sunderland.
8. Jones N.C and Pevzner P.A., (2005). *An Introduction to Bioinformatics Algorithms*, Ane Books, New Delhi.
9. Lesk M., (2004). *Introduction to Bioinformatics*, Oxford University Press.
10. Bergeron B.M.D., (2003). *Bioinformatics Computing – The Complete Practical Guide to Bioinformatics for Life Scientists*, Pearson Education (Singapore) Pvt. Ltd., Delhi.
11. Rastogi P.S.C., Namita M and Rastogi P., (2004). *Bioinformatics Concepts, Skills and Applications*, CBS Publishers, New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER) :

1. www.ncbi.nlm.nih.gov
2. www.uniprot.org
3. www.rcsb.org
4. https://prosite.expasy.org
5. www.ncbi.nlm.nih.gov/blast/
6. www.ebi.ac.uk/Tools/msa/clustalo
7. www.megasoftware.net/
8. https://spdbv.vital-it.ch/
9. www.autodock.scripps.edu/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids

UNIT -1	TITLE			
1.1	Statistical analysis with MS-EXCEL	5	Chalk & Talk	Black Board
1.2	Biological databases – NCBI, UniProt	5	Chalk & Talk	LCD
1.3	Sequence retrieval from biological databases	5	Lecture	PPT & White board
1.4	Sequence similarity analysis – BLAST, FastA	5	Lecture	Smart Board
1.5	Multiple sequence alignment – ClustalO	5	Lecture	Black Board
1.6	Phylogenetic analysis – MEGA6	5	Discussion	Google classroom
1.7	Protein Structure visualization – PDB, Rasmol	5	Specimen	Microscope
1.8	Homology modeling - SWISSPDB Viewer	5	Discussion	Black Board

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Apply MS-EXCEL for statistical analysis of biological data	**K3**	PSO1& PSO11
CO 2	Find and retrieve nucleotide, protein sequences and protein structure from biological database	**K1**	PSO11
CO 3	Demonstrate sequence similarities analysis using BLAST and FastA tools	**K2**	PSO11
CO 4	Analyze the protein structure using Swiss-PDP viewer	**K4**	PSO11
CO 5	Illustrate the biological interactions of target protein and drugs	**K2**	PSO11

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	3	2
CO3	2	2	2	2	2	2	2	2	2	2	3	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2	2	3	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	2	2	2
CO2	2	3	2	2
CO3	2	3	2	2
CO4	2	2	2	2
CO5	2	2	2	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**
 Weakly Correlated -**1**

COURSE DESIGNER:
Dr. J. Asnet Mary

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I M.Sc., ZOOLOGY

SEMESTER –II

For those who joined in 2019 onwards

(For Zoology, Home science students)

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS	CREDITS
PSZO	19PAD2CA	SPSS	Lecture & Practical	40 Hrs.	4

COURSE DESCRIPTION

It provides hands on experience on the tools and techniques of SPSS statistical package.

COURSE OBJECTIVES

To gain skills on analysis of data and interpretation using SPSS software

COURSE CONTENT

1. Introduction to Research Methodology- Testing Hypothesis
2. Data Entry in SPSS through Questionnaire, Importing Data
3. Charting with SPSS- explore, PP plots and QQ Plots and Interpretations
4. Descriptive analysis – Measures of Central Tendency, Kurtosis, Skewness
5. One Sample t test – Independent and Paired sample t test
6. Correlation – Pearson - Regression analysis– Simple Linear, R square
7. Factorial ANOVA, F- Statistics and p values
8. Hierarchical Clustering with SPSS -Interpretation and Report Writing

REERENCES

1. Ajaj S.G and Sanjaya S. G., (2009).*Statistical Methods for Practice and Research:* A Guide to Data Analysis Using SPSS (Response Books) 2nd Edition, Kindle Edition. Sage Publications Pvt. Ltd; 2 edition (13 May 2009)

2. Kiran P., Smruti B and Sanjay S., (2011).*SPSS in Simple Steps Paperback.*
3. George D., Mallery P., English N.A., George D and Mallery P., (2016). *IBM SPSS Statistics 23 Step by Step*: A Simple Guide and Reference.
4. KayyanaramanK.,Hareesh N.R and Harikumar P.N., (2016).*Statistical Methods for Research*: A Step by Step Approach Using IBM SPSS Hardcover – Atlantic Publications.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER) :

1. https://www.spss-tutorials.com/basics/
2. https://www.udemy.com/course/spss-statistics-foundation-course-from-scratch-to-advanced/
3. https://www.open.edu/openlearn/society-politics-law/sociology/getting-started-spss/content-section-
4. https://ezspss.com/one-way-anova-in-spss-including-interpretation/
5. https://statistics.laerd.com/statistical-guides/descriptive-inferential-statistics.php

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
SPSS OFF CLASS				
1.1	Introduction to Research Methodology- Testing Hypothesis	5	Chalk & Talk	Black Board
1.2	Data Entry in SPSS through Questionnaire, Importing Data	5	Demonstration	LCD
1.3	Charting with SPSS- explore, PP plots and QQ Plots and Interpretations	5	Lecture	LCD
1.4	Descriptive analysis – Measures of Central Tendency, Kurtosis, Skewness	5	Lecture	Smart Board

1.5	One Sample t test – Independent and Paired sample t test	5	Lecture	LCD
1.6	Correlation – Pearson - Regression analysis– Simple Linear, R square	5	Software	LCD
1.7	Factorial ANOVA, F-Statistics and p values	5	SPSS software	LCD
1.8	Hierarchical Clustering with SPSS -Interpretation and Report Writing	5	Software	LCD

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Apply the knowledge of research to frame the questionnaire based on hypothesis	**K3**	PSO1, PSO3, PSO5& PSO9
CO 2	Organize the data in the form of Chart and diagrams using SPSS	**K3**	PSO1 & PSO3
CO 3	Analyze the data using descriptive statistics, T test, correlation and regression	**K4**	PSO3, PSO5, PSO9 & PSO11
CO 4	Demonstrate ANOVA and Hierarchical Clustering using SPSS software	**K2**	PSO3, PSO5, PSO9 & PSO11
CO 5	Interpret the results obtained through SPSS analysis tools	**K5**	PSO3, PSO5, PSO9 & PSO11

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12

CO1	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**
CO2	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**
CO3	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**
CO4	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**
CO5	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

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II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	**19PG3Z11**	**Biophysics**	**Lecture**	**6**	**5**

COURSE DESCRIPTION

Biophysics which is an inter disciplinary course, deals with the discipline concerned with the application of the principles and methods of physics and the other physical sciences to the solution of biological problems.

COURSE OBJECTIVES

- To imbibe the principles of physics involved in the structure elucidation of biomolecules
- To understand the principles of energy transformation in living systems
- To apply the use of modern physical instruments to unravel the importance of therapeutic radiology, in which the measurement of dose is critical to treatment, and in diagnostic radiology, particularly with techniques involving isotopes

UNITS:

UNIT-I: CHEMCAL BONDS AND MOLECULAR INTERACTIONS [15 HRS.]

Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide bond, Peptide bonds- Forces between Molecules: Electrostatic force, Van der Waal's forces, hydrophobic and hydrophilic - Biological importance and domains of Physics in Biology-Electrolytic dissociation and electrolytes:- Ionisation, Basis of acidity and Basicity, Bronsted Lowry theory, strength of acids and bases, Henderson and Hasselbalch equation. Water as Dipole -Biological importance of water

Self-Study:-Water as Dipole -Biological importance of water,Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide

bond, Peptide bonds- Forces between Molecules: Electrostatic force, Van der Waal's forces, hydrophobic and hydrophilic

UNIT-II: THERMODYNAMICS AND BIOLOGICAL OXIDATION [15 HRS.]Laws of Thermodynamics: Concept of free energy and entropy, Exergonic and Endergonic reactions, Rate of reactions - Effect of sunlight and temperature on reactions - Energy of Activation: Arrhenius expression, Diffusion: Fick's Laws-I & II law, constant laws, Osmotic coefficient: Gibbs Donnan equilibrium- Oxidation and reduction reactions: Redox potentials in biological system- High energy phosphate group: ATP synthesis in mitochondria, ATP synthase.

UNIT-III: INSTRUMENTATION [15 HRS.]

Principle, Components and Biological applications of Light microscope, Polarising microscope, Inverted microscope, Confocal and X-ray microscope, Flow cytometry - Colorimetry and Spectrophotometry: Laws of absorption, complementary colours, Chromophore concept, Absorption spectrum, Wavelength selectors, Detection devices, amplification and read out. Chromatography: Paper chromatography, TLC and Column chromatography. Centrifugation: Principle, Types & Applications, Relative Centrifugal Force, Factors affecting sedimentation and types of centrifugation.

UNIT-IV: PHOTO BIOPHYSICS [15 HRS.]

Electromagnetic spectrum: Components of EMR, Quantum theory of radiation, Biological application, Effects of UV on Biological systems - Radioactive isotopes: Measurements of radiation, Dosimetry, Cerenkov radiation, Interaction of radioactivity with matter, Gas ionization methods: Ionization chambers, proportional counters, GM tubes, Photographic methods: Autoradiography, Excitation method: Liquid Scintillation counters; Use of isotopes as tracers in Biology; Safety aspects.

Self-Study:-Use of isotopes as tracers in Biology; Safety aspects, Effects of UV on Biological systems

UNIT-V: BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY [15 HRS.]

Biophysical aspects of vision: photoreceptors :simple and compound, structure and function of vertebrate eye, mechanism of conversion of light: Biophysical aspects of hearing, noise and speech-mechanism of hearing-auditory and non-auditory effects of noise pollution; stimulation to neuronal impulse - Nerve conduction: Neurotransmitters and Synapse, Nerve impulse, membrane potential, resting potential and action potential, Action potentials in earthworm nerve fiber - Muscle contraction.

Self-Study:-Neurotransmitters and Synapse

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)

REFERENCES:

1. Claycomb J.J, Tran J.Q.P., (2011) *Introductory Biophysics: Perspectives on the living state, Jones and Bartlett publishers*, New Delhi.
2. Upadhyay A, Upadhyay K and Nath N., (2007) *Biophysical chemistry Principles and Techniques, Himalaya Publishing House Pvt.* Ltd., Mumbai.
3. Narayanan P, (2007) *Essentials of Biophysics, New Age International (P) Ltd.,* Publishers, New Delhi.
4. Nolting B., (2005) *Methods in modern Biophysics, Springer (India) private Ltd.,* New Delhi.
5. Cotterill R., (2004) *Biophysics and Introduction, John Wiley and Sons* Ltd., printed in India by Replika press pvt. Ltd., Kundli
6. Agarwal S.K., (2005) *Advanced Biophysics, APH publishing corporation,* New Delhi.
7. Pattabhi V and Gautham N., (2004) *Biophysics*, Narosa Publishing House, New Delhi.

DIGITAL OPEN EDUCATION RESOURCES (DOER):

1. http://oer.iain-padangsidimpuan.ac.id/items/show/98

2. https://www.oercommons.org/authoring/15047-basic-thermodynamics/view
3. https://www.oercommons.org/courseware/lesson/56957
4. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Fundamentals/Ionic_and_Covalent_Bonds
5. https://www.khanacademy.org/science/ap-biology/chemistry-of-life/introduction-to-biological-macromolecules/a/chemical-bonds-article

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1	**CHEMCAL BONDS AND MOLECULAR INTERACTIONS**			
1.1	Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide bond, Peptide bonds-	2	Discussion	Black Board
1.2	Forces between Molecules: Electrostatic force, Van der Waal's forces, hydrophobic and hydrophilic	2	Chalk & Talk	LCD
1.3	Biological importance and domains of Physics in Biology	2	Lecture	PPT & White board
1.4	Electrolytic dissociation and electrolytes:- Ionisation, Basis of acidity and Basicity,	3	Lecture	Smart Board
1.5	Bronsted Lowry theory, strength of acids and bases,	2	Lecture	Black Board
1.6	Henderson and Hasselbalch equation.	1	Chalk &Talk Discussion	Google classroom
1.7	Water as Dipole -Biological importance of water	3	Lecture	Black Board
UNIT-2	**THERMODYNAMICS AND BIOLOGICAL OXIDATION**			
2.1	Laws of Thermodynamics: Concept of free energy	2	Lecture	Green Board Charts
2.2	Entropy, Exergonic and Endergonic reactions,	2	Chalk & Talk	Green Board

2.3	Rate of reactions - Effect of sunlight and temperature on reactions	2	Discussio n	Black Board
2.4	Energy of Activation: Arrhenius expression	1	Chalk & Talk	Green Board
2.5	Diffusion: Fick's Laws-I & II law,	2	Lecture	PPT & White board
2.6	constant laws, Osmotic coefficient	1	Lecture	Smart Board
2.7	Gibbs Donnan equilibrium-	2	Lecture	Black Board
2.8	Oxidation and reduction reactions: Redox potentials in biological system	1	Chalk & Talk Discussio n	Google classroom
2.9	High energy phosphate group : ATP synthesis in mitochondria, ATP synthase.	2	Lecture	Black Board
UNIT-3 INSTRUMENTATION				
3.1	Principle, Components and Biological applications of Light microscope	1	Chalk &Talk	Black Board
3.2	Principle, Components and Biological applications of Polarising microscope	1	Chalk & Talk	LCD
3.3	Principle, Components and Biological applications of Inverted microscope	1	Lecture	PPT & White board
3.4	Principle, Components and Biological applications of Confocal microscope	1	Lecture	Smart Board
3.5	Principle, Components and Biological applications of X-ray microscope	1	Lecture	Black Board
3.6	Flow cytometry	1	Discussio n	Google classroom
3.7	Colorimetry and Spectrophotometry: Laws of absorption, complementary colours	2	Lecture	Black Board
3.7	Chromophore concept, Absorption spectrum, Wavelength selectors, Detection devices, amplification and read out	2	Lecture	Black Board
3.8	Chromatography: Paper chromatography	1	Lecture	Black Board

3.9	TLC	1	Lecture	PPT & White board
3.10	Column chromatography	1	Lecture	PPT & White board
3.11	Centrifugation: Principle, Types & Applications, Relative Centrifugal Force	1	Lecture	PPT &White board
3.12	Factors affecting sedimentation and types of centrifugation	1	Chalk & Talk	Green Board
UNIT-4 PHOTO BIOPHYSICS				
4.1	Electromagnetic spectrum: Components of EMR	1	Chalk & Talk	Black Board
4.2	Quantum theory of radiation	2	Chalk &Talk	LCD
4.3	Biological application	2	Lecture	PPT & White board
4.4	Effects of UV on Biological systems	1	Lecture	Smart Board
4.5	Radioactive isotopes: Measurements of radiation, Dosimetry	2	Lecture	Black Board
4.6	Cerenkov radiation and Interaction of radioactivity with matter	1	Discussio n	Google classroom
4.7	Gas ionization methods: Ionization chambers, proportional counters, GM tubes	2	Lecture	Black Board
4.7	Photographic methods: Autoradiography,	2	Lecture	Black Board
4.8	Excitation method: Liquid Scintillation counters	1	Lecture	Black Board
4.9	Use of isotopes as tracers in Biology; Safety aspects	1	Lecture	Black Board
UNIT-5 BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY				
5.1	Biophysical aspects of vision: photoreceptors: simple and compound	2	Chalk & Talk	Black Board
5.2	Structure and function of vertebrate eye,	2	Chalk & Talk	LCD
5.3	Mechanism of conversion of light stimulation to neuronal impulse	2	Lecture	PPT & White board
5.4	Biophysical aspects of hearing, noise and speech-mechanism of	2	Lecture	Black Board

	hearing-auditory and non-auditory effects of noise pollution			
5.5	Nerve conduction: Neurotransmitters and Synapse	2	Lecture	Smart Board
5.6	Membrane potential, resting potential and action potential,	2	Lecture	Black Board
5.7	Action potentials in earthworm nerve fiber	2	Discussion	Google classroom
5.8	Muscle Contraction	2	Lecture	Black Board

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	**4**	**4**	**-**	**-**	**-**	**8**	-	**8**	20 %
K3	**2**	**2**	**-**	**5**	**-**	**9**	-	**9**	22.5 %
K4	**2**	**2**	**-**	**-**	**5**	**9**	-	**9**	22.5 %
K5	**2**	**2**	**5**	**-**	**-**	**9**	-	**9**	22.5 %
Non Scholastic	**-**	**-**	**-**	**-**	-		**5**	**5**	12.5 %
Total	**10**	**10**	**5**	**5**	**5**	**35**	**5**	**40**	**100 %**

CIA

Scholastic	**35**
Non Scholastic	**5**

40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Classify the chemical bonds and forces interacting between molecules and determine the theories involved in acidity and basicity	K2	PSO1& PSO2
CO 2	Apply the principles of Thermodynamics and biological oxidation in living organisms	K3	PSO2
CO 3	Determine the principle, procedure, components involved and biological applications of Instruments	K3	PSO1
CO 4	Analyse the principle, properties, instrumentation and biological applications of Electromagnetic radiation	K4	PSO4
CO 5	Assess the principles of Photobiology in the Biophysical aspects of Vision and neurophysiology applied to the Animals	K5	PSO1 & PSO2

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	3	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2

CO3	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**2**	**2**
CO2	**3**	**2**	**2**	**2**
CO3	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

2. Dr.N.MALATHI

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II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG3Z12	Immunology	Lecture	6	5

COURSE DESCRIPTION

The course intends to provide the biology of immune system and mechanism of immune response, maturation of lymphocytes and major histocompatibility complex and immune system related disorders and vaccines.

COURSE OBJECTIVES

To understand the functions of immune system and to envisage the different immune response in human health.

UNITS

UNIT –I OVERVIEW OF THE IMMUNE SYSTEM (15 HRS.)

Historical perspective (Overview) - Innate (Nonspecific) and adaptive (Specific) immunity – Cells of the immune system: B-lymphcytes, T lymphocytes, mononuclear cells, granulocytic cells (Neutrophils, Eosinophils, Basophils), Mast cells, Dendritic cells – Primary lymphoid organs: Thymus, Bone marrow, Lymphatic system – Secondary lymphoid organs: Lymph nodes, spleen, MALT, Bursa of Fabricius. Primary immune response and secondary immune response.

Self-study – Secondary lymphoid organs

UNIT –II ANTIGENS AND ANTIBODIES (15 HRS.)

Antigen-structure and properties, Haptens, Adjuvants, Epitopes: B cell epitope and T cell epitope. **Antibody**: Immunoglobulin - structure, classes biological functions. Characteristics - Isotypes - Allotypes - Idiotypes - Immunoglobulin super family, monoclonal and polyclonal antibodies. Organization and rearrangement of light-chain genes (κ & λ chain) and Heavy chain genes - Antigen–Antibody interactions, Immunodiffusion and immunoelectrophoresis.Agglutination, Precipitation, Hybridoma Technology.

Self-study - B cell epitopes and T cell epitopes.

UNIT –III LYMPHOCYTES MATURATION AND ACTIVATION & MHC (15 HRS.)

B-cell maturation – B cell activation and proliferation - affinity maturation – class switching – generation of plasma cells and memory B cells - General organization and inheritance of MHC – MHC Genes - Structure of MHC molecules – Class I & II - Processing and presentation of exogenous and endogenous antigens - Tissue typing - T-cell maturation: Thymic selection – T cell activation – T cell differentiation.

Self-study - Structure of MHC molecules – Class I & II

UNIT –IV COMPLEMENT SYSTEM AND HYPERSENSITIVITY (15 HRS.)

Complement activation pathways: Classical, Alternate and Lectin - Regulation of complement system - Biological consequences of complement activation - Complement deficiencies. Hypersensitive reactions – IgE mediated (Type I) Hypersensitivity: components, mechanism, mediators and consequences – Antibody mediated cytotoxic hypersensitivity (Type II) – Immune complex mediated Types III hypersensitivity and T_{DTH} mediated Type IV hypersensitivity.

Self-study - Biological consequences of complement activation

UNIT –V VACCINE AND IMMUNITY IN HEALTH AND DISEASE (15 HRS.)

Vaccines: Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines. Immune response and immune evasion during bacterial (Tuberculosis), Parasitic (Malaria) and viral (HIV) infections.Congenitalimmunodeficiency diseases (SCID and Ataxia). Autoimmunity: Organ- specific autoimmune diseases. Systemic auto-immune diseases.

Self-study - Congenital immunodeficiency diseases

REFERENCES:

1. Owen J, Punt J, Stranford S.A. (2013). *Kuby Immunology*. 7th ed., Macmillan, International Ed..

2. Rao C.V. (2007). *A text book of Immunology*, 3rd ed., Narosa Publishing House, New Delhi.
3. Parham P. (2014). *The Immune System*, Fourth Edition, Garland Science Publisher, USA.
4. Chakravarthy A.K. (2003). *Immunology*, 2nd ed., N.L. Publishers. Siliguri.
5. Lydyard P.M, Whelan A, Fanger M.W. (2003). *Instant notes on Immunology*. Viva Books Private Limited. New Delhi.
6. Clark W.R. (1991). *The experimental foundations of modern Immunology*, 4th ed., John Wiley and Sons, INC.
7. Roitt I.M. (1988). *Essential Immunology*, 6th ed., English Language Book Society/ Blackwell Scientific Publications.
8. Emil R. U., Benacerraf B. (1984). *Text book of Immunology*, 2nd Ed., Williams and Wilkins, Baltimore, London.
9. Mc Connell, Munro A, Waldmann H. (1984). *The Immune System*, 2nd Ed., Blackwell Scientific Publication.
10. Hyde R.M. (1977). *Immunology*, 3rd Ed., B.I.W. Waverly Pvt Ltd New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://pubmed.ncbi.nlm.nih.gov/30426422/
2. https://www.nature.com/articles/nrrheum.2017.125
3. https://www.oercommons.org/courses/vaccination
4. https://www.ncbi.nlm.nih.gov/books/NBK562228/
5. http://www.ncbi.nlm.nih.gov/books/NBK27092/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1	**OVERVIEW OF THE IMMUNE SYSTEM**			

1.1	Historical perspective (Overview)	1	Discussio n	Black Board
1.2	Innate (Nonspecific) immunity	1	Chalk & Talk	LCD
1.3	adaptive (Specific) immunity	1	Lecture	PPT & White board
1.4	Cells of the immune system: B-lymphcytes, T lymphocytes, mononuclear cells,	1	Lecture	Smart Board
1.5	granulocytic cells (Neutrophils, Eosinophils, Basophils), Mast cells, Dendritic cells	1	Lecture	Black Board
1.6	Primary lymphoid organs: Thymus	1	Chalk & Talk Discussio n	Google classroom
1.7	Bone marrow, Lymphatic system	2	Lecture	Black Board
1.8	Secondary lymphoid organs: Lymph nodes,	1	Discussio n	Black Board
1.9	Spleen, MALT, Bursa of Fabricius.	1	Lecture	Black Board
1.10	Primary immune response and secondary immune response		Lecture	Black Board
UNIT -2 ANTIGENS AND ANTIBODIES				
2.1	**Antigen**-structure and	1	Lecture	Green Board Charts
2.2	Properties of antigen, Haptens, Adjuvants,	2	Chalk & Talk	Green Board
2.3	B cell epitopes – Properties	1	Discussio n	Black Board
2.4	T cell epitope – Properties	1	Chalk & Talk	LCD
2.5	Immunoglobulin - structure,	1	Lecture	PPT & White board
2.6	classes of Ig – Structure and biological functions of IgG.	1	Lecture	Smart Board
2.7	Structure and biological functions of IgA, IgM	1	Lecture	Black Board
2.8	Structure and biological functions of IgD and IgE	1	Chalk & Talk Discussio n	Google classroom
2.9	Characteristics - Isotypes - Allotypes - Idiotypes - Immunoglobulin super family,	1	Lecture	Black Board

2.10	monoclonal and polyclonal antibodies. – Hybridoma Technology – Method	1	Discussio n	Black Board
2.11	Hybridoma Technology applications	1	Lecture	Black Board
2.12	Organization and rearrangement of light-chain genes (κ & λ chain	1	Lecture	Black Board
2.13	Organization and rearrangement of Heavy chain genes	1	Lecture	Black Board
2.14	Antigen–Antibody interactions, Immunodiffusio n Agglutination, Precipitation	1	Lecture	Black Board
2.15	immunoelectrophoresis.	1	Lecture	Black Board
2.16	B cell epitopes – Properties	1	Discussio n	Black Board
2.17	T cell epitope – Properties	1	Chalk & Talk	LCD
UNIT -3 LYMPHOCYTES MATURATION AND ACTIVATION & MHC				
3.1	B-cell maturation& B cell activation	3	Chalk &Talk	Black Board
3.2	B- Cell proliferation, affinity maturation – class switching	3	Chalk & Talk	LCD
3.3	generation of plasma cells and memory B cells	1	Lecture	PPT & White board
3.4	MHC Genes - Structure of MHC molecules – Class I & II	2	Lecture	Smart Board
3.5	Processing and presentation of exogenous antigens	1	Lecture	Black Board
3.6	Processing and presentation of endogenous antigens	1	Discussio n	Google classroom
3.7	Tissue typing	1	Lecture	Black Board
3.7	T-cell maturation	2	Lecture	Black Board
3.8	Thymic selection – T cell activation - T cell differentiation	1	Lecture	Black Board
UNIT -4 COMPLEMENT SYSTEM AND HYPERSENSITIVITY				
4.1	Complement activation pathways: Classical	1	Chalk & Talk	Black Board
4.2	Complement activation pathways: Alternate	2	Chalk & Talk	LCD
4.3	Lectin pathways	2	Lecture	PPT & White board
4.4	Regulation of complement system	1	Lecture	Smart Board

4.5	Biological consequences of complement activation	2	Lecture	Black Board
4.6	Complement deficiencies	1	Discussion	Google classroom
4.7	Hypersensitive reactions – IgE mediated (Type I) Hypersensitivity	2	Lecture	Black Board
4.7	Antibody mediated cytotoxic hypersensitivity	2	Lecture	Black Board
4.8	Immune complex mediated Types III hypersensitivity	1	Lecture	Black Board
4.9	T_{DTH} mediated Type IV hypersensitivity	1	Lecture	Black Board
UNIT -5 VACCINE AND IMMUNITY IN HEALTH AND DISEASE				
5.1	Vaccines: Whole organism vaccines, - Heat killed vaccines, Attenuated vaccines	2	Chalk & Talk	Black Board
5.2	Purified macromolecules as Vaccines, Recombinant vector vaccines,	3	Chalk & Talk	LCD
5.3	Synthetic peptide vaccines, Multivalent subunit vaccines.	2	Lecture	PPT & White board
5.4	Immune response and immune evasion during bacterial (Tuberculosis),	1	Lecture	Smart Board
5.5	Parasitic (Malaria)	1	Lecture	Black Board
5.6	viral (HIV) infection	1	Discussion	Google classroom
5.7	Congenital immunodeficiency diseases (SCID and Ataxia).	2	Lecture	Black Board
5.8	Autoimmunity, Organ- specific autoimmune diseases, Systemic auto-immune diseases	3	Discussion	Black Board

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment

	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	**4**	**4**	**-**	**-**	**-**	**8**	-	**8**	20 %
K3	**2**	**2**	**-**	**5**	**-**	**9**	-	**9**	22.5 %
K4	**2**	**2**	**-**	**-**	**5**	**9**	-	**9**	22.5 %
K5	**2**	**2**	**5**	**-**	**-**	**9**	-	**9**	22.5 %
Non Scholastic	**-**	**-**	**-**	**-**	-		**5**	**5**	12.5 %
Total	**10**	**10**	**5**	**5**	**5**	**35**	**5**	**40**	**100 %**

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**CIA**	**ESE**	**Total**
10	**10**	**5**	**5**	**5**	**5**	**40**	**60**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Summarize the overview of the immune system	**K4**	PSO1 & PSO5
CO 2	Elaborate the structure and properties of antigen and antibody and its interactions.	**K1**	PSO1 & PSO9
CO 3	Determine the concept of MHC molecules and maturation and activation of lymphocyte.	**K1**	PSO1 &PSO5
CO 4	Analyze the complement system and the types of hypersensitivity reactions.	**K2**	PSO1 & PSO9
CO 5	Prioritize the types of vaccines and immunity in health and disease.	**K4**	PSO1 & PSO9

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	2	2	2	2	2	3	2	2	2
CO3	3	2	2	2	3	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	3	2	2	2
CO5	3	2	2	2	2	2	2	2	3	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	2	2	2	2
CO2	3	3	2	2
CO3	3	2	2	2
CO4	3	3	2	2
CO5	3	3	2	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**

 Weakly Correlated -**1**

COURSE DESIGNER:

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II M.Sc.,ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG3Z13	Biostatistics & Research Methodology	Lecture	6	5

COURSE DESCRIPTION

This course deals with specific procedures or techniques used to identify and process the research data.

COURSE OBJECTIVES

- Identify the research problem and generation of raw data through different methods.
- Apply the statistical tools to calculate and tabulate the data.
- Interpret the results and draw conclusion.
- Outline the steps in drafting the thesis.

UNITS

UNIT –I INTRODUCTION TO BIOSTATISTICS (18 HRS.)

Introduction, Definitions, Types of biological data, Sampling – types, samples from populations, graphical frequency distribution and graphical representation of data.Measures of central tendency - Mean, Median, and Mode. Dispersion & variability – the range and the mean deviation, the variance, standard deviation, the coefficient of variance, standard error.

Self – study - Introduction, Definitions, Types of biological data, Sampling – types, samples from populations, graphical frequency distribution and graphical representation of data.

UNIT -II DISTRIBUTION AND TESTING OF HYPOTHESIS (18 HRS.)

The normal distribution- skewness & kurtosis, proportions of a normal curve – Z scores - Testing of hypothesis - Importance & types – Chi – square test – comparison of means of two large samples, means of two small samples, paired & unpaired t tests.

UNIT -III CORRELATION & REGRESSION (18 HRS.)

Correlation analysis-Kinds, Degree - Types of correlation- Pearson's Correlation Coefficient -Regression analysis- Simple, linear regression, testing the significance of regression. The analysis of variance - Single factor ANOVA – basic assumptions under ANOVA, One Way and Two-Way ANOVA.

UNIT -IV INTRODUCTION TO RESEARCH & RESEARCH DESIGN

(18 HRS.)

Research: Definition, Importance, Meaning of research –Characteristics of research –Types of Research – Research approaches (Qualitative and Quantitative)- significance of research. Research problem: Identification, Selection and formulation of research problem –Research design: Features and concepts -Dependent and independent variables, research hypothesis – Types.

Self – study- Research report-components, tables, figures, formatting and typing

UNIT –V THESIS WRITING (18HRS.)

Preparation and Writing of Thesis: Components of thesis – Literature collection - Literature citation- Research report-components, tables, figures, formatting and typing. Literature review – Source, structure and stages of literature search – critical review.Preparing of scientific papers for publication to a Journal and presenting in symposia/seminar, Plagiarism - Types. Ethics in research.

Self – study- Research report-components, tables, figures, formatting and typing

TEXT BOOK:

Ramakrishnan P., (2010). Biostatistics, Saras publication, Nagercoil, Tamil Nadu.

REFERENCES:

15. Kothari. C.R., (2009). *Research Methodology*, New Age International,

16. Khan and Khanum., (2004).*Fundamentals& Biostatistics*, 2nd ed., Ukaaz Publications, Hyderabad.
17. Gurumani N., (2010). *An Introduction to Biostatistics*, MJP Publishers, Chennai.
18. Satguru Prasad., (2012). *Elements of Biostatistics*, Rastogi publications, Meerut.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

6. http://www.oercommons.org/courses/biostatistics-methods-2/view
7. https://www.oercommons.org/courses/chi-square-test-08-54
8. https://www.oercommons.org/courses/anova-calculations
9. https://www.oercommons.org/authoring/21429-wp-12-1-additional-test-of-two-population-variance/view
10. https://vivaopen.oercommons.org/courseware/unit/420

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 INTRODUCTION TO BIOSTATISTICS				
1.1	Introduction, Definitions, Types of biological data	2	Chalk & Talk	Black Board
1.2	Sampling – types, samples from populations	3	Chalk & Talk	LCD
1.3	Graphical frequency distribution and graphical representation of data	3	Lecture	PPT & White board
1.4	Measures of central tendency - Mean, Median, and Mode.	4	Lecture	Black Board
1.5	Dispersion & variability – the range and the mean deviation, the variance	3	Lecture	Black Board
1.6	Standard deviation, the coefficient of variance, standard error.	3	Lecture	Black Board
UNIT -2 DISTRIBUTION AND TESTING OF HYPOTHESIS				

2.1	The normal distribution- skewness & kurtosis, proportions of a normal curve – Z scores	4	Lecture	Black Board
2.2	Testing of hypothesis - Importance & types	3	Chalk & Talk	Black Board
2.3	Chi – square test	3	Chalk & Talk	Black Board
2.4	Comparison of means of two large samples, means of two small samples	5	Chalk & Talk	Black Board
2.5	Paired & unpaired t tests	3	Lecture	White board
UNIT -3 CORRELATION & REGRESSION				
3.1	Correlation analysis-Kinds, Degree - Types of correlation-Pearson's Correlation Coefficient	4	Chalk & Talk	Black Board
3.2	Regression analysis- Simple, linear regression, testing the significance of regression.	5	Chalk & Talk	Black Board
3.3	The analysis of variance - Single factor ANOVA – basic assumptions under ANOVA	5	Lecture	White board
3.4	One Way and Two Way ANOVA	4	Lecture	Black Board
UNIT-4 INTRODUCTION TO RESEARCH & RESEARCH DESIGN				
4.1	**Research: Definition, Importance, Meaning of research**	4	Chalk & Talk	Black Board
4.2	Characteristics of research – Types of Research – Research approaches (Qualitative and	4	Chalk & Talk	Black Board

	Quantitative)- significance of research.			
4.3	Research problem: Identification, Selection and formulation of research problem	4	Lecture	White board
4.4	Research design: Features and concepts -Dependent and independent variables	4	Lecture	Black Board
4.5	Research hypothesis – Types	2	Lecture	Black Board
UNIT –5 THESIS WRITING				
5.1	Preparation and Writing of Thesis	2	Chalk & Talk	Black Board
5.2	Components of thesis	2	Chalk & Talk	Black Board
5.3	Literature collection - Literature citation	3	Lecture	White board
5.4	Research report-components, tables, figures, formatting and typing.	4	Lecture	Black Board
5.5	Literature review – Source, structure and stages of literature search – critical review.	4	Lecture	Black Board
5.6	Preparing of scientific papers for publication to a Journal and presenting in symposia/seminar	4	Lecture	Black Board
5.7	Plagiarism – Types	3	Lecture	Black Board

5.8	Ethics in research		Discussio n	

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	4	4	-	-	-	8	-	8	20 %
K3	2	2	-	5	-	9	-	9	22.5 %
K4	2	2	-	-	5	9	-	9	22.5 %
K5	2	2	5	-	-	9	-	9	22.5 %
Non Scholastic	-	-	-	-	-		5	5	12.5 %
Total	10	10	5	5	5	35	5	40	100 %

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Organise the research data in appropriate order and apply the measures of central tendency and dispersion values.	**K3**	PSO3
CO 2	Assess the difference between the expected and observed frequencies by Chi-Square test for testing of hypothesis	**K5**	PSO2
CO 3	Compute degrees of relationship variables using Correlation and Regression analysis.	**K3**	PSO 11
CO 4	Examine the Concepts of Research and devise the Research Hypothesis.	**K4**	PSO 7& PSO8
CO 5	Parapharse the research work through documentation as a Thesis, Oral or Poster Presentation.	**K2**	PSO 5

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10	PSO11	PSO12
CO1	2	2	3	2	2	2	2	2	2	2	2	2

CO2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO5	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**2**	**3**	**2**	**2**
CO2	**2**	**3**	**2**	**2**
CO3	**2**	**3**	**2**	**2**
CO4	**2**	**3**	**2**	**2**
CO5	**2**	**3**	**2**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:
Dr. X. Devanya Rosaline
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MADURAI-625 018

HOD'S Signature & Name

II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG3ZE1	Fisheries & Aquaculture	Lecture	4	4

COURSE DESCRIPTION

This Course focuses on Fisheries and Aquaculture of Finfishes, Marine Prawn, Pearl Oyster and Disease Management.

COURSE OBJECTIVES

To impart knowledge on Fisheries and Aquaculture Practices in India.

UNIT I - INDIAN CAPTURE FISHERIES (15 HRS)

History of Fisheries, Indian Capture Fisheries: Riverine fisheries, Estuarine fisheries, Reservoir fisheries, Lacustrine Fisheries, Cold-water fisheries; Marine Capture fisheries: Inshore capture fisheries, Off shore and deep sea fisheries

UNIT II - AQUACULTURE PRACTICES (15 HRS)

Preparation and Construction of Ponds; Water Quality Management; Maintenance of Fish Farms; Fish Nutrition – Live feed, Artificial feed - FCR; Induced Breeding – Eyestalk ablation and Hypophysation.

UNIT III - CULTURE SYSTEMS (15 HRS)

Culture Systems – Based on habitat, expenses, site, climatic conditions and Composition of Organisms Culture of Indian Major Carps, Marine Prawn, Pearl Oyster and Sea Cucumber - Sewage fed fish culture, Integrated Fish Farming.

UNIT IV - FISH PATHOLOGY AND POST HARVEST TECHNOLOGY

(15 HRS)

Parasitic diseases – Protozoan, Helminth, Crustacean, Fungal, Bacterial and Viral diseases and Deficiency Diseases; Preservation of Fish; Fish Marketing

UNIT V - INDIAN FISHERY (15 HRS)

Indian Fish Geography, Fishing Gears and Methods, Fishing Crafts; Indian Exclusive Economic Zone – Use of Remote Sensing and GIS.Role of Government and Public Sector on Indian Fisheries, FFDAs.

REFERENCE BOOKS:

1. Pandey K. and Shukla J.P., (2012) *Fish and Fisheries*, 3rd Revised ed., Rastogi Publications, Meerut.

2. Srivastava C.B.L., (2008) *A Textbook of Fishery Science and Indian Fisheries*, 3rd Revised ed., Published by KitabMahal, Allahabad.

3. Kumar R., (2012) *Fish Farming Management*, 1st ed., Arise Publishers and Distributors, New Delhi.

4. Chandrasekhar Y.S., (2013) *Fish Nutrition in Aquaculture*, 1st ed., Swastik Publications, New Delhi.

5. Reddy S.M. and Sambasiva Rao K.R.S., (1999) *A Textbook of Aquaculture*, Discovery Publishing House, New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

7. http://ecoursesonline.iasri.res.in/course/index.php?categoryid=72
8. https://nfdb.gov.in/
9. https://indianfisheries.icsf.net/
10. https://www.india.gov.in/topics/agriculture/fisheries
11. http://eprints.cmfri.org.in/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT-1 INDIAN CAPTURE FISHERIES				
1.1	History of Fisheries	2	Chalk & Talk	Black Board
1.2	Indian Capture Fisheries: Riverine fisheries, Estuarine fisheries, Reservoir fisheries, Lacustrine Fisheries, Cold-water fisheries	7	Chalk & Talk	LCD
1.3	Marine Capture fisheries: Inshore capture fisheries, Off shore and deep sea fisheries	5	Lecture	PPT & White board
UNIT-2 AQUACULTURE PRACTICES				
2.1	Preparation and Construction of Ponds	4	Lecture	Charts

2.2	Water Quality Management	2	Chalk & Talk	PPT& Videos
2.3	Maintenance of Fish Farms	2	Chalk & Talk	PPT
2.4	Fish Nutrition – Live feed, Artificial feed – FCR	3	Chalk & Talk	PPT& Videos
2.5	Induced Breeding – Eyestalk ablation and Hypophysation	2	Chalk & Talk	PPT
UNIT-3 CULTURE SYSTEMS				
3.1	Culture Systems – Based on habitat, expenses, site, climatic conditions and Composition of Organisms	2	Lecture	PPT& Videos
3.2	Culture of Indian Major Carps, Marine Prawn, Pearl Oyster and Sea Cucumber	5	Lecture	PPT& Videos
3.3	Sewage fed fish culture	2	Chalk & Talk	PPT& Videos
3.4	Integrated Fish Farming.	3	Chalk & Talk	PPT& Videos
UNIT-4 FISH PATHOLOGY AND POST HARVEST TECHNOLOGY				
4.1	Parasitic diseases – Protozoan, Helminth, Crustacean, Fungal, Bacterial and Viral diseases and Deficiency Diseases	10	Chalk & Talk	PPT& Videos
4.2	Preservation of Fish	2	Chalk & Talk	PPT& Videos
4.3	Fish Marketing	2	Lecture	PPT& Videos
UNIT-5 INDIAN FISHERIES				
5.1	Indian Fish Geography	2	Chalk & Talk	PPT& Videos
5.2	Fishing Gears and Methods, Fishing Crafts	5	Chalk & Talk	PPT& Videos

5.3	Indian Exclusive Economic Zone – Use of Remote Sensing and GIS.	2	Chalk & Talk	PPT& Videos
5.4	Role of Government and Public Sector on Indian Fisheries, FFDAs.	4	Chalk & Talk	PPT & Videos

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	**4**	**4**	**-**	**-**	**-**	**8**	-	**8**	20 %
K3	**2**	**2**	**-**	**5**	**-**	**9**	-	**9**	22.5 %
K4	**2**	**2**	**-**	**-**	**5**	**9**	-	**9**	22.5 %
K5	**2**	**2**	**5**	**-**	**-**	**9**	-	**9**	22.5 %
Non Scholastic	-	-	-	-	-		**5**	**5**	12.5 %
Total	**10**	**10**	**5**	**5**	**5**	**35**	**5**	**40**	**100 %**

CIA

Scholastic	**35**
Non Scholastic	**5**

40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Identify the economically important fishes and fishery products.	K1	PSO1& PSO2
CO 2	Plans according to the recent concepts in fisheries management.	K3	PSO3
CO 3	Distinguish the various aquaculture systems.	K2	PSO5
CO 4	Organizes the type of hatchery, brood stock, larval production, feed management water quality and disease management in cultivable species, live feed production.	K3	PSO4, PSO9
CO 5	Evaluates the Fisheries and Aquaculture Practices in India.	K4	PSO5, PSO7 & PSO10

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	3	2	2	2	2	3	2	2	2	2
CO3	2	2	2	3	2	2	3	2	2	2	2	3
CO4	2	2	2	2	2	3	2	2	3	2	3	2
CO5	2	3	2	2	3	2	2	2	-	3	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	2	2	2
CO2	2	2	2	2
CO3	2	2	2	3
CO4	2	2	3	2
CO5	2	3	2	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**

 Weakly Correlated -**1**

COURSE DESIGNER:
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II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG3ZE2	Bioinformatics	Lecture	4	4

COURSE DESCRIPTION

The course provides an outline on various DNA sequencing methods, and principle and methods of sequence analysis with various bioinformatics tools and macromolecular structure prediction.

COURSE OBJECTIVES

To understand the fundamentals of biological sequence analysis and principle of substitution matrices, phylogenetic tree construction and protein structure prediction.

UNITS

UNIT –I DNA SEQUENCING AND BASICS OF INTERNET (12 HRS.)

Sanger's, Chemical, and Automated methods - Hierarchical sequencing and shot gun sequencing - Human Genome Project.Networking in computers: Intranet and internet - TCP/IP, file transfer protocols, web browsers, internet addresses, domain names, basic concepts of HTML, HTTP, web search engines.

Self-study - concepts of HTML, HTTP, web search engines

UNIT –II BIOLOGICAL DATABASES (12 HRS.)

Classification of Biological Databases, Nucleic acid sequence databases: GenBank, EMBL, DDBJ - Protein sequence databases: UNIPROT, Secondary Databases: PROSITE, PRINTS - Genome Databases, Gene Expression database: GEO, Chemical Structure database: PubChem, and Pathway database: KEGG.

Self-study – DDBJ, PRINTS

UNIT –III PAIRWISE ALIGNMENT (12 HRS.)

Pair-wise alignment: Types - Global and local alignment; gapped and ungapped alignment – DOTPLOT, Dynamic programming: Needleman-Wunsch algorithm - Substitution matrices: PAM, BLOSUM - Word methods– Sequence similarity tools: working principle and types of BLAST.

Self-study – DOTPLOT

UNIT –IV MULTIPLE SEQUENCE ALIGNMENT (12 HRS.)

Multiple Sequence alignment: Progressive method and iterative method - applications - ClustalO– Phylogenetic analysis: Orthologs, paralogs, xenologs - Typical structure of phylogenetic tree - types: rooted and unrooted tree, phylogram and cladogram, Phylogenetic algorithm: Phenetic method (UPGMA) – Cladistic method (Maximum parsimony).

Self-study – ClustalO, Cladistic method

UNIT –V STRUCTURE PREDICTION & DRUG DESIGNING (12 HRS.)

Classification of proteins (Review) – Structure databases – Structural classification databases: SCOP, CATH - Secondary structure prediction – Chou-Fasman method, GOR method, Nearest neighbourhood method – Three dimentional structure prediction: homology modeling, threading, *ab initio* – Structure based drug design (SBDD).

Self-study – Structural classification databases

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only) (12 HRS.)

REFERENCES:

1. Baxevanis D and Francis B.F., (2004). *Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins*, 3rd ed., John Wiley & Sons Inc.
2. Attwood T.K and Parrysmith D.J., (2005). *Introduction to Bioinformatics*, Pearson Education.
3. Campbell M.A and Heyer L.J., (2004). *Discovering Genomics, Proteomics and Bioinformatics*, Pearson Education.
4. Gibson G and Muse S.V., (2002). *A Primer of Genomic Science*, Sinauer Associates Inc. Pub., Sunderland.

5. Jones N.C and Pevzner P.A., (2005). *An Introduction to Bioinformatics Algorithms*, Ane Books, New Delhi.
6. Lesk M., (2004). *Introduction to Bioinformatics*, Oxford University Press.
7. Bergeron B.M.D., (2003). *Bioinformatics Computing – The Complete Practical Guide to Bioinformatics for Life Scientists*, Pearson Education (Singapore) Pvt. Ltd., Delhi.
8. Rastogi P.S.C., Namita M and Rastogi P., (2004). *Bioinformatics Concepts, Skills and Applications*, CBS Publishers, New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. www.ncbi.nlm.nih.gov
2. www.uniprot.org
3. www.rcsb.org
4. https://prosite.expasy.org
5. www.ncbi.nlm.nih.gov/blast/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 DNA SEQUENCING AND BASICS OF INTERNET				
1.1	Sanger's DNA sequencing	2	Chalk & Talk	Black Board
1.2	Chemical sequencing	1	Chalk & Talk	LCD
1.3	Automated methods	1	Lecture	PPT & White board
1.4	Hierarchical sequencing	2	Lecture	Smart Board
1.5	Shot gun sequencing	2	Lecture	Black Board
1.6	Human Genome Project	3	Discussion	Google classroom
1.7	Networking in computers: Intranet and internet - TCP/IP,	1	Lecture	Black Board
1.8	file transfer protocols, web browsers, internet addresses,	1	Discussion	Black Board
1.9	domain names, basic concepts of HTML, HTTP,	1	Lecture	Black Board

2.0	web search engines	1	Lecture	Black Board
UNIT -2 BIOLOGICAL DATABASES				
2.1	Classification of Biological Databases,	1	Lecture	Green Board Charts
2.2	Nucleic acid sequence databases: GenBank,	2	Chalk & Talk	Green Board
2.3	EMBL, DDBJ	1	Chalk & Talk	Black Board
2.4	Protein sequence databases: UNIPROT	2	Chalk & Talk	LCD
2.5	Secondary Databases: PROSITE	1	Lecture	PPT & White board
2.6	PRINTS	1	Lecture	Smart Board
2.7	Genome Databases	2	Lecture	Black Board
2.8	Gene Expression database: GEO	2	Discussion	Google classroom
2.9	Chemical Structure database: PubChem Pathway database: KEGG	1	Lecture	Black Board
UNIT -3 PAIRWISE ALIGNMENT				
3.1	Pair-wise alignment: Types - Global and local alignment	2	Chalk & Talk	Black Board
3.2	gapped and ungapped alignment – DOTPLOT	2	Chalk & Talk	LCD
3.3	Dynamic programming: Needleman-Wunsch algorithm	2	Lecture	PPT & White board
3.4	Substitution matrices: PAM	2	Lecture	Smart Board
3.5	BLOSUM	2	Lecture	Black Board
3.6	Word methods–	2	Discussion	Google classroom
3.7	Sequence similarity tools: working principle and types of BLAST	3	Lecture	Black Board
UNIT -4 MULTIPLE SEQUENCE ALIGNMENT				

4.1	Multiple Sequence alignment: Progressive method	2	Chalk & Talk	Black Board
4.2	iterative method & applications	2	Chalk & Talk	LCD
4.3	ClustalO	2	Lecture	PPT & White board
4.4	Phylogenetic analysis: Orthologs, paralogs, xenologs	2	Lecture	Smart Board
4.5	Typical structure of phylogenetic tree - types: rooted and unrooted tree, phylogram and cladogram,	2	Lecture	Black Board
4.6	Phylogenetic algorithm: Phenetic method (UPGMA)	3	Discussio n	Google classroom
4.7	Cladistic method (Maximum parsimony)	2	Lecture	Black Board
UNIT -5 STRUCTURE PREDICTION & DRUG DESIGNING				
5.1	Classification of proteins (Review)	1	Chalk & Talk	Black Board
5.2	Structure databases- PDB	2	Chalk & Talk	LCD
5.3	Structural classification databases: SCOP, CATH	2	Lecture	PPT & White board
5.4	Secondary structure prediction – Chou-Fasman method	2	Lecture	Smart Board
5.5	GOR method, Nearest neighbourhood method	2	Lecture	Black Board
5.6	Three dimentional structure prediction: homology modeling, threading, *ab initio*	3	Discussio n	Google classroom
5.7	Structure based drug design (SBDD)	3	Lecture	Black Board

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment

	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	**4**	**4**	**-**	**-**	**-**	**8**	-	**8**	20 %
K3	**2**	**2**	**-**	**5**	**-**	**9**	-	**9**	22.5 %
K4	**2**	**2**	**-**	**-**	**5**	**9**	-	**9**	22.5 %
K5	**2**	**2**	**5**	**-**	**-**	**9**	-	**9**	22.5 %
Non Scholastic	**-**	**-**	**-**	**-**	-		**5**	**5**	12.5 %
Total	**10**	**10**	**5**	**5**	**5**	**35**	**5**	**40**	**100 %**

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**CIA**	**ESE**	**Total**
10	**10**	**5**	**5**	**5**	**5**	**40**	**60**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED	PSOs ADDRESSED

		BLOOM'S TAXONOMY)	
CO 1	Summarize the Human Genome Project, shotgun sequencing, web browsers and search engines and flatfile of biological databases.	**K2**	PSO1,PSO2, PSO3, PSO5 & PSO11
CO 2	Explain DOTPLOT , dynamic programming using Needleman-Wunsch Algorithm and development in significance of substitution matrices	**K2**	PSO1, PSO3, PSO5 & PSO11
CO 3	Make use of different PAM and BLOSUM for closely and distantly related sequences, Multiple sequence alignment	**K3**	PSO1,PSO2, PSO5 & PSO11
CO 4	Examine Model Phylogenetic tree based on the distance matrix	**K4**	PSO1,PSO2, PSO3, PSO5 & PSO11
CO 5	Determine the secondary structure and three dimensional structure prediction methods	**K5**	PSO1,PSO2, PSO3, PSO5 & PSO11

Mapping of COs with PSOs

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO2	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO3	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO5	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	3	3	2
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	3	3	2
CO5	3	3	3	2

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:
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SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PGSZO	19PG3Z14	Lab in Biophysics & Biostatistics	Practical	4	2

COURSE DESCRIPTION

The course is designed to give a hand on experience in Biophysics and biostatistics

COURSE OBJECTIVES

On completion of the course, students should be able to develop skill in performing experiments, analysis and interpretation of the result.

BIOPHYSICS

1. pH Meter: Standardization of pH meter, Preparation of Buffers.
2. pH titration curve of acid-base
3. Osmolarity: Determination of osmotic pressure of salts.
4. To study the characteristics of absorption spectra of Aromatic Amino Acids.
5. To study the characteristics of absorption spectra of Proteins
6. Colorimeter: Verification of Beer's Lambert law, determination of absorption maxima of coloured compounds, and molar extinction coefficient.
7. Estimation of percent purities of dyes and inorganic compound
8. Centrifuge – Principle and techniques.
9. Separation of aminoacid mixture using paper chromatography
10. Surface tension by drop weight method
11. Comparison of Viscosity of two liquids

BIOSTATISTICS

1. Collection of data and representation - histogram, curves and pie diagrams.
2. Calculation of mean, median, mode, standard deviation, standard error, variance and coefficient of variation - individual observation
3. Calculation of mean, median, mode, standard deviation, standard error, variance and coefficient of variation – continuous series.
4. Calculation of correlation coefficient – width/diameter of shell.
5. Calculation of correlation coefficient – height and weight of students in the class.
6. Calculation of regression co-efficient using length and width of leaves.
7. Probability experiment with coin tossing (one coin, two coins). using chi square test
8. Test of significance for small samples – student's t test.

REFERENCES:

1. Rajan S., Christy, S.R., (2011) *Experimental procedures in Life Sciences,*Anjana Book House, Chennai.
2. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) *Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.*
3. Tembhare D.B., (2008) *Techniques in Life Sciences, 1st ed.*, Himalaya Publishing House Pvt. Ltd., Mumbai.
4. Dutta A., (2009*) Experimental Biology Lab manual*, Narosa Publishing House, New Delhi.
5. Palanivelu P., (2004) *Analytical Biochemistry and Separation Techniques – A laboratory manual for B.Sc and M.Sc students, 3rd ed.*, Kalaimani Printers, Madurai.
6. Wilson K and Walker J., (2013) *Principles and Techniques of Biochemistry and Molecular Biology, 7th ed.,* Cambridge University Press, New York.
7. Roe S., (2001) *Protein Purification Techniques – A Practical Approach, 2nd* ed., Oxford University Press.
8. Boyer R., (2000) *Modern Experimental Biochemistry, 3rd ed.,* Pearson Education Inc.
9. Wilson K and Kenneth H.G., (1992) *A Biologists Guide to Principles and Techniques of Practical Biochemistry, 3rd ed.*, Cambridge University Press, Cambridge, UK.
10. Khan I.A and Khanum A., (2004) *Fundamentals & Biostatistics, 2nd ed.*, Ukaaz Publications, Hyderabad.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://vlab.amrita.edu/index.php?sub=3&brch=258
2. https://bms.ucsf.edu/resources-learning-biostatistics
3. https://nextgenu.org/mod/url/view.php?id=31720
4. https://instr.iastate.libguides.com/oer/stats
5. https://www.biophysics.org/education-careers/education-resources/additional-education-resources

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
BIOPHYSICS				
1	pH Meter: Standardization of pH meter, Preparation of Buffers.	4	Chalk & Talk	pH meter
2	pH titration curve of acid-base	4	Hands on training	pH meter
3	Determination of osmotic pressure of salts.	4	Hands on training	sample
4	Absorption spectra of Aromatic Amino Acids.	4	Hands on training	Colorimeter
5	characteristics of absorption spectra of Proteins	4	Hands on training	Colorimeter
6	Colorimeter: Verification of Beer's Lambert law, determination of absorption maxima of coloured compounds, and molar extinction coefficient.	4	Chalk & Talk	Colorimeter
7	Estimation of percent purities of dyes and inorganic compound	4	Hands on training	colorimeter
8	Centrifuge – Principle and techniques.	4	Chalk & Talk	centrifuge
9	Separation of amino acid mixture using paper chromatography	4	Hands on training	Filter paper
10	Surface tension by drop weight method	4	Hands on training	Instrument
BIOSTATISTICS				
11	Collection of data and representation - histogram, curves and pie diagrams.	4	Lecture	Green Board
12	Measures of Central tendency – individual observation	4	Hands on training	Leaves/Shell
13	Measures of Central tendency – continuous series	4	Hands on training	Leaves/Shell
14	Calculation of correlation coefficient – width/diameter of shell	4	Hands on training	Leaves/Shell

15	Calculation of correlation coefficient – height and weight of students in the class.	4	Hands on training	Meter scale/Weighing machine
16	Calculation of regression co-efficient using length and width of leaves/Shell	4	Hands on training	Leaves/Shell
17	Probability experiment with coin tossing (one coin, two coins). using chi square test	4	Hands on taining	Coin
18	Test of significance for small samples – student's t test.	4	Chalk & Talk	Green Board

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

Evaluation Pattern

MARKS		
CIA	**ESE**	**Total**
40	**60**	**100**

COURSE OUTCOMES

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

NO.	**COURSE OUTCOMES**	**KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)**	**PSOs ADDRESSED**
CO 1	Recall the principle of centrifuge, pH meter, Chromatography	**K1**	PSO1, PSO3, PSO5
CO 2	Determine the maximum absorption and its molar extinction coefficient of sample	**K5**	PSO3, PSO5
CO 3	Estimate the pH Titration curve, Surface tension and viscosity of sample	**K5 & K6**	PSO3

CO 4	Interpret the results for statistical analysis including mean, median, mode and Standard deviation for individual, continuous series	**K2 & K5**	PSO3&PSO7 &PSO11
CO 5	Determine the correlation, regression and significance for the statistical data	**K5**	PSO3 & PSO5, PSO11

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**2**	**3**	**3**	**2**
CO2	**2**	**3**	**3**	**2**
CO3	**2**	**3**	**3**	**2**
CO4	**2**	**3**	**3**	**2**
CO5	**2**	**3**	**3**	**2**

Note: Strongly Correlated – **3** Moderately Correlated – **2**

 Weakly Correlated -**1**

COURSE DESIGNER:
Dr. N. Nagarani

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II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS

PGSZO	**19PG3Z15**	**Lab in Immunology, Fisheries & Aquaculture and Bioinformatics**	**Practical**	**4**	**2**

COURSE DESCRIPTION

It focuses on techniques related to the field of immunology. It includes preparation of antigens and to visualize precipitin and agglutination

COURSE OBJECTIVES

To perform hemoagglutination, single immunodiffusion, double immunodiffusion, and also to be familiarized with the principle of ELISA, immunoelectrophoresis, rocket immunoelectrophoresis.

EXPERIMENTS

1. Laboratory safety guidelines and Animal ethics
2. Lymphoid organs – Thymus (Chick), Spleen (Goat)
3. Separation of serum & plasma
4. Total Leukocyte Count (TLC)
5. Separation of lymphocytes from peripheral blood
6. Isolation of splenocytes from goat
7. Antigen preparation and immunization
8. Isolation of serum immunoglobulins
9. Haemagglutination titration
10. Immunodiffusion techniques – single and double immunodiffusion
11. Immunoelectrophoresis- Demonstration
12. Rocket Immunoelectrophoresis- Demonstration
13. Complement mediated hemolysis
14. Spotters: ELISA
15. Biological databases – NCBI
16. Sequence analysis – BLAST, ClustalO
17. Field visit to aquarium

REFERENCES:

1. Sinha, J, Chatterjee, A.K, Chatoopadhya, P. (2015). *Advanced practical Zoology*, 4th Edition, Books and Allied, (P) Ltd.
2. Dutta A. (2009). *Experimental Biology A laboratory Manual*, Narosa Publishing House, New Delhi.
3. Nigam A and Ayyagari A. (2008). *Lab manual in Biochemistry, Immunology, and Biotechnology,* 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Tembhare, DB. (2008). *Techniques in Life Sciences*, 1st Edition, Himalaya Publishing House.
5. Rao, CV. (2007). *A text book of Immunology*, 3rd edition, Narosa Publishing House, New Delhi.
6. Philopose, P.M., (2006). *Experimental Biotechnology*, 1st Edition, Dominant Publishers and Distributors, New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://pubmed.ncbi.nlm.nih.gov/30426422/
2. https://www.nature.com/articles/nrrheum.2017.125
3. www.ncbi.nlm.nih.gov
4. www.ncbi.nlm.nih.gov/blast/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1				
1.1	Laboratory safety guidelines and Animal ethics	3	Lecture	Blackboard
1.2	Lymphoid organs – Thymus (Chick), Spleen (Goat)	3	Demonstration	Specimen
1.3	Separation of serum & plasma	4	Hands on training	Specimen

1.4	Total Leukocyte Count (TLC)	4	Hands on training	Specimen
1.5	Separation of lymphocytes from peripheral blood	4	Hands on training	Specimen
1.6	Isolation of splenocytes from goat	4	Hands on training	Specimen
1.7	Antigen preparation and immunization	4	Hands on training	Tissue sample
1.8	Isolation of serum immunoglobulins	4	Lecture & Demonstration	Blackboard & Specimen
1.9	Haemagglutination titration	4	Hands on training	Kit
1.10	Immunodiffusion techniques – single and double immunodiffusion	4	Hands on training	Kit
1.11	Immunoelectrophoresis-Demonstration	4	Hands on training	Kit
1.12	Rocket Immunoelectrophoresis-Demonstration	4	Hands on training	Kit
1.13	Complement mediated hemolysis	4	Hands on training	Kit
1.14	Spotters: ELISA	2	Observation	Diagram
1.15	Biological databases – NCBI	4	Hands on training	Online software
1.16	Sequence analysis – BLAST, ClustalO	4	Hands on training	Online software
1.17	Field visit to aquarium	-	On the spot study	-

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

Evaluation Pattern

MARKS		
CIA	**ESE**	**Total**
40	**60**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Explain the different lymphoid organs, properties of soluble and particulate antigen	**K2**	PSO1, PSO2, & PSO3
CO 2	Estimate the lymphocytes from peripheral blood and explain the biological databases NCBI	**K2**	PSO2 & PSO3
CO 3	Construct various bleeding techniques and separation of serum and plasma and plan a visit to aquarium.	**K3**	PSO3

CO 4	Examine the experiment with complement mediated lysis, Immunoelectrophoresis and rocket immunoelectrophoresis identification and single / double immunodiffusion	**K4**	PSO2 & PSO3
CO 5	Analyze the sequences BLAST AND ClustalO and Assess the formation of perciptin line and button formation	**K5**	PSO2 & PSO3

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO2	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO5	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**

Mapping of COs with Pos

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**2**
CO3	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**
□ Weakly Correlated -**1**

COURSE DESIGNER:

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I M.Sc.,Zoology

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG4Z16	Environmental Biology	Lecture	6	5

COURSE DESCRIPTION

To understand the basic concepts of Ecology.

COURSE OBJECTIVES

To understand the key aspects of ecology, impact of pollution and biodiversity conservation for sustainable development

UNIT –I ECOSYSTEM AND HABITAT (18 HRS.)

Structure, Components of ecosystems - Food chain, Food web, Trophic level Ecological pyramids,Productivity, Energy flow and mineral cycling (CNP). Classification of ecosystems- Introduction, structure and function of terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine) ecosystems. Concept of habitat and niche ecosystem, Biomes - Tundra, Forest, Desert and mountain biomes, Biogeography: biogeographical zones of India.

Self-Study - Structure – Components of ecosystems - Food chain, Food web - Ecological pyramids

UNIT –IIPOPULATION AND COMMUNITY ECOLOGY (18 HRS.)

Concept of population: Natality, Mortality, Biotic potential, Survivorship curves, Life table, Age structure, Carrying capacity, Environmental resistance, Population growth forms, Life history strategies (r and k selection), Population fluctuations, Population interactions- Competition, Predation, Parasitism and Mutualism - Concept of Community: Structure, Composition, Stratification and Community Function. Ecological succession – Primary and Secondary succession, Climax community - Hydrarch, Xerarch. Ecotone and Edge effect, Ecological equivalents, Ecotypes and Ecophenes.

Self-Study - Population interactions- Competition, Predation, Parasitism, Mutualism

UNIT –III NATURAL RESOURCES (18 HRS.)

Renewable & Non–renewable resources: Renewable Resources – Biofuel (Biomass, Biogas, Biohydrogen), Solar energy, Wind Energy, Tidal Energy and Geothermal Energy. Non-Renewable resources –Fossil fuel (Coal, Petrol & Natural Gas) and Nuclear Fuels.Water resources: Distribution – Global, National, Regional, Types – surface water & ground water, Management and conservation of water resources.

Self study -Distribution –Global, National, Regional

UNIT –IV ENVIRONMENTAL POLLUTION (18 HRS.)

Impact of pollutants on general fauna, flora and ecosystems - Environmental pollution: Causes, effects and control measures of air, water, soil, noise and nuclear pollution-–Waste water management – Primary & secondary treatment; Global Climatic change - *El nino* and *La nino* Phenomenon- Green peace movement- Chipko movement- Nuclear disarmament - Role of Government agencies - Central and state Pollution Control Boards- Paris Summit & Kyoto protocol.

Self-Study - Environmental pollution: Causes, effects and control measures of air, water, soil, noise and nuclear pollution

UNIT –V BIODIVERSITY CONSERVATION (18 HRS.)

Concepts of Biodiversity, Need for conservation, Conservation strategies- *In situ* conservation - Protected areas, National parks, Sanctuaries, Biosphere reserves and Sacred groves; *Ex situ* Conservation - Seed Banks, Gene banks. Sthalvirukshas, Animal Translocation, Human animal conflicts and management. Endangered Animals - IUCN Red Data Book, endemism. Environmental Protection Act (1986), Forest conservation Act (1980), Biodiversity Act (2002). Remote sensing and GIS: Methods and Applications in environmental management.

Self-study - Concepts of Biodiversity- Need for conservation

REFERENCES:

1. Odum, E.P. and Barrett, G.W. (2005) *Fundamental of Ecology. 5th* Ed., Cengage Learning India. New Delhi.
2. Primark R.B., (2000) *A Primer of Conservation Biology. 2nd Ed.*, SinauerAssociates..
3. Kormondy, E.J. (1996) *Concepts of Ecology. 4th Ed.*, PHI Cengage Learning India, New Delhi).
4. Peter J.R., Stephan, L.W., PauleH., Ceche S. &Bevlerly, M. (2008) *Ecology*. Cengage learning India,New Delhi.
5. Wright, R.T.(2008) *Environmental Science*, 10th Ed., Pearson Education, New Delhi.
6. Smith T.M. & Smith R.L. (2008) *Elements of Ecology*. 6th Ed., Pearson Education, New Delhi.
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1. https://openoregon.pressbooks.pub/envirobiology/
2. https://bio.libretexts.org/Bookshelves/Botany/Book%3A_Botany_Lab_Manual_(Morrow)/02%3A_Introduction_to_Ecology
3. https://cnx.org/contents/AK5sUWpu@1.1:GNNbYBSX@1/Global-Processes
4. https://bio.libretexts.org/Bookshelves/Ecology/Book%3A_Environmental_Biology_(Fisher)
5. https://www.nationalgeographic.org/encyclopedia/ecosystem/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1	**ECOSYSTEM AND HABITAT ECOLOGY**			
1.1	Structure, Components of ecosystems - Food chain, Food web	2	Chalk & Talk	Black Board
1.2	Trophic level Ecological pyramids,Productivity,	2	Chalk & Talk	LCD
1.3	Energy flow and mineral cycling (CNP).	3	Lecture	PPT & White board
1.4	Classification of ecosystems- Introduction, structure and function of terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine) ecosystems.	3	Lecture	PPT
1.5	aquatic (fresh water, marine, estuarine) ecosystems	3	Lecture	Black Board
1.6	Concept of habitat and niche ecosystem	2	Lecture	Google classroom
1.7	Biomes - Tundra, Forest, Desert and mountain biomes	2	Lecture	PPT
1.8	Biogeography: biogeographical zones of India.	1	Discussion	Black Board
UNIT -2	**POPULATION AND COMMUNITY ECOLOGY**			
2.1	Concept of population: Natality, Mortality, Biotic potential, Survivorship curves, Life table, Age structure, Carrying capacity, Environmental resistance	3	Lecture	Green Board Charts
2.2	Population growth forms, Life history strategies (r and k	3	Chalk & Talk	Green Board

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
	selection), Population fluctuations			
2.3	Population interactions- Competition, Predation, Parasitism and Mutualism	3	Chalk & Talk	Black Board
2.4	Concept of Community: Structure, Composition, Stratification and Community Function	3	Chalk & Talk	LCD
2.5	Ecological succession – Primary and Secondary succession	2	Lecture	PPT &White board
2.6	Climax community - Hydrarch, Xerarch	2	Lecture	PPT
2.7	Ecotone and Edge effect	1	Lecture	Black Board
2.8	Ecological equivalents, Ecotypes and Ecophenes	1	Lecture	Google classroom
UNIT -3NATURAL RESOURCES				
3.1	Renewable & Non–renewable resources: Renewable Resources – Biofuel (Biomass, Biogas, Biohydrogen)	3	Chalk & Talk	Black Board
3.2	Solar energy, Wind Energy, Tidal Energy and Geothermal Energy.	3	Chalk & Talk	LCD
3.3	Non-Renewable resources – Fossil fuel (Coal, Petrol & Natural Gas) and Nuclear Fuels.	4	Lecture	PPT & White board
3.4	Water resources: Distribution – Global, National, Regional	4	Lecture	PPT
3.5	Types – surface water & ground water	2	Lecture	Black Board

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
3.6	Management and conservation of water resources.	2	Lecture	Google classroom
UNIT -4 ENVIRONMENTAL POLLUTION				
4.1	Impact of pollutants on general fauna, flora and ecosystems, Environmental pollution: Causes, effects and control measures of air	2	Chalk & Talk	Black Board
4.2	water, soil pollution	2	Chalk & Talk	LCD
4.3	noise and nuclear pollution	2	Lecture	PPT & White board
4.4	Waste water management – Primary & secondary treatment; Global	2	Lecture	PPT
4.5	Climatic change - *El Nino* and *La Nina* Phenomenon	2	Lecture	Black Board
4.6	Green peace movement, Chipko movement, Nuclear disarmament	4	Lecture	Google classroom
4.7	Role of Government agencies - Central and state Pollution Control Boards	2	Lecture	Google classroom
4.8	Paris Summit & Kyoto protocol	2	Lecture	Google classroom
UNIT -5 BIODIVERSITY CONSERVATION				
5.1	Concepts of Biodiversity, Need for conservation, Conservation strategies	2	Discussion	Google classroom

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
5.2	*In situ* conservation - Protected areas, National parks, Sanctuaries, Biosphere reserves and Sacred groves	4	Chalk & Talk	Black Board
5.3	*Ex situ* Conservation - Seed Banks, Gene banks. Sthalvirukshas	3	Discussion	Google classroom
5.4	Animal Translocation, Human animal conflicts and management	2	Chalk & Talk	Black Board
5.5	Endangered Animals - IUCN Red Data Book, endemism	3	Chalk &Talk	LCD
5.6	Environmental Protection Act (1986), Forest conservation Act (1980), Biodiversity Act (2002)	2	Lecture	Black Board
5.7	Remote sensing and GIS: Methods and Applications in environmental management	2	Lecture	Google classroom

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1	T2	Seminar	Assignment	OBT/PPT				
	10 Mks.	10 Mks.	5 Mks.	5 Mks	5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	4	4	-	-	-	8	-	8	20 %
K3	2	2	-	5	-	9	-	9	22.5 %
K4	2	2	-	-	5	9	-	9	22.5 %
K5	2	2	5	-	-	9	-	9	22.5 %

Non Scholastic	**-**	**-**	**-**	**-**	**-**		**5**	**5**	12.5 %
Total	**10**	**10**	**5**	**5**	**5**	**35**	**5**	**40**	**100 %**

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**CIA**	**ESE**	**Total**
10	**10**	**5**	**5**	**5**	**5**	**40**	**60**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Develop an understanding of ecological key interactions and processes	**K6**	PSO1& PSO3
CO 2	Explain the factors involved in determining population size, Density, Distribution &Community function	**K5**	PSO1& PSO 3
CO3	Analyze sustainable utilization of natural resources	**K4**	PSO3 &PSO7
CO4	Agree significance of Biodiversity, consequences on loss of Biodiversity& conservation Strategies	**K5**	PSO7& PSO8

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 5	Criticize various kinds of pollution in the environment, their impact on the ecosystem & impact of climatic change	K5	PSO6 &PSO8

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	3	3	3	3	3	3	2	2	2	2	3
CO2	3	3	3	3	3	3	3	2	2	2	2	2
CO3	3	3	3	3	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	3	3	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	3	3

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**
□ Weakly Correlated -**1**

COURSE DESIGNER:
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II M.Sc. ZOOLOGY

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
PSZO	19PG4Z17	Biotechnology	Lecture	6	5

COURSE DESCRIPTION

This course provides knowledge about genetic engineering and rDNA technology and its application in gene therapy, cell culture and GM food.

COURSE OBJECTIVES

- To familiarize the use of tools and techniques of genetic engineering for the study of living organisms, or derivatives to make or modify products for specific use for human welfare.
- Understand DNA finger printing and its application,
- Know about the application of animal cell culture for *in vitro* testing of drugs.

UNITS

UNIT –I RECOMBINANT DNA TECHNOLOGY (18HRS.)

Scope and importance of rDNA technology – Tools of rDNA technology: Enzymes involved in rDNA technology - Linkers and Adaptors – Cloning vectors: bacterial plasmid vectors – pBR322, pUC vectors – Agrobacterium based plasmids –cosmids – shuttle vectors - λ and M13 phage vectors – YAC - Simian virus 40, BAC and Transposons.

Self-study – Scope and importance of rDNA technology – Tools of rDNA technology: Enzymes involved in rDNA technology

UNIT –II TECHNIQUES OF GENETIC ENGINEERING (18 HRS.)

Gene transfer techniques: Transformation, Transduction, Biolistic, Microinjection, Liposome fusion, Electroporation, and agroinfection - Selection of recombinants: Reporter genes, Blue-white selection method -

preparation of cDNA- Hybridization techniques - DNA finger printing: RFLP & PCR techniques - Genomic library - Blotting techniques: Southern, Northern and Western blotting.

UNIT –III ANIMAL BIOTECHNOLOGY (18 HRS.)

Basics of animal cell, tissue and organ culture - Primary culture and established cell line culture - Basic techniques of mammalian cell culture and application -Organ culture ,whole embryo culture Embryo transfer and splitting - *In vitro* fertilization (IVF) technology - Nuclear transplantation: Dolly - Manipulation of reproduction in animals-Transgenic animals-strategies for gene transfer, Targeted gene transfer, Artificial insemination, Animal Bioreactor and Molecular Farming, Human gene therapy, Cryobiology.

UNIT –IV PLANT BIOTECHNOLOGY (18 HRS.)

Introduction to the techniques of plant tissue culture - Historical background – Basic requirements for a tissue culture lab - Totipotency - Requirements for cell and tissue culture - Nutrient media - culture of plant materials - single cell culture, Organogenesis: Root and Shoot culture, Micropropagation-Somaclonal variation - Somatic embryogenesis and production of embryoids: Haploid and double haploid production - Protoplast isolation and culture, Somatic hybridization and Cybrid production and their applications in crop improvement - GM foods.

Self-study – GM foods

UNIT –V REGENERATIVE MEDICINE (18 HRS.)

Stem cells: Types, isolation umbilical cord blood cells, mesenchymal cells –- Current status and application in medicine, Application of animal cell culture for *in vitro* testing of drugs; Production of recombinant hemoglobin, blood substituents, Artificial blood, General account of *in vitro* regulation of blood cells production - Bioethics of stem cell research.

Self-study – Stem cells: Types, isolation umbilical cord blood cells

REFERENCES:

1. Bernard G.R and Jack P.J., (2002) *Molecular Biotechnology:* Principles and Applications of recombinant DNA, Indian reprint,Panima Publishing Corporation, New Delhi.
2. Das H.K., (2007) *Textbook of Biotechnology*, 3rd ed., Wiley India (p) Ltd., New Delhi.
3. Selvaraj L., (2013) *Stem Cells*, 1st ed., MJP Publishers, Chennai.
4. Dubey R.C., (2004*) A Text book of Biotechnology*, 3rd ed., S. Chand and company Ltd., New Delhi.
5. Brown T.A., (2004) *Gene cloning and DNA analysis*, 6th ed., Wiley-Blackwell Science, Osney Mead, Oxford.
6. Old R.W. and Primrose, S.B.,(1985) *Principles of Gene Manipulations*, An introduction to Genetic Engineering, Oxford Blackwell Publishers, London.
7. Winnacker E.L., (2003) *From Genes to Clones,* Panima Publishing Corporation, New Delhi.
8. Sree Krishna V., (2007) *Bioethics and Biosafety in Biotechnology*, 1st ed., New Age International Publishers, New Delhi.
9. Helen K and Adrianne M., (2001) *Recombinant DNA and Biotechnology: A Guide for students,* 2nd ed., American Society for Microbiology Press, Washington D.C, USA.

DIGITAL OPEN EDUCATIONAL RESOURCES(DOER):

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/
2. https://facultystaff.richmond.edu/~lrunyenj/bio554/lectnotes/chapter14.pdf
3. https://www.ncbi.nlm.nih.gov/books/NBK9950/
4. https://www.ncbi.nlm.nih.gov/books/NBK21881/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4876001/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 RECOMBINANT DNA TECHNOLOGY				
1.1	Linkers and Adaptors	2	Chalk & Talk	Black Board
1.2	Cloning vectors: bacterial plasmid vectors	3	Chalk & Talk	LCD
1.3	pBR322, pUC vectors	3	Lecture	PPT
1.4	Agrobacterium based plasmids - cosmids	3	Lecture	Black Board
1.5	shuttle vectorsλ and M13 phage vectors –	3	Lecture	Black Board
1.6	YAC - Simian virus 40, BAC	2	Chalk & Talk	Black Board
1.7	Transposons	2	Chalk & Talk	Black Board
1.8	Self-study – Scope and importance of rDNA technology – Tools of rDNA technology: Enzymes involved in rDNA technology		Discussion	
UNIT -2	**TECHNIQUES OF GENETIC ENGINEERING**			
2.1	Gene transfer techniques: Transformation	3	Chalk & Talk	Black Board
2.2	Biolistic, Microinjection, Liposome fusion, Electroporation, and agroinfection	3	Chalk & Talk	LCD
2.3	Transduction, - Selection of recombinants: Reporter genes,	2	Lecture	PPT
2.4	Blue-white selection method	1	Chalk & Talk	LCD
2.5	preparation of cDNA	1	Lecture	Black Board
2.6	Hybridization techniques - DNA finger printing: RFLP & PCR techniques	3	Chalk & Talk	Black Board

2.7	Genomic library - Blotting techniques: Southern, Northern and Western blotting.	3	Chalk & Talk	Black Board
UNIT -3 ANIMAL BIOTECHNOLOGY				
3.1	Basics of animal cell, tissue and organ culture - Primary culture and established cell line culture	2	Chalk & Talk	Black Board
3.2	Basic techniques of mammalian cell culture and application	2	Chalk & Talk	LCD
3.3	Organ culture ,whole embryo culture Embryo transfer and splitting	3	Lecture	PPT
3.4	*In vitro* fertilization (IVF) technology - Nuclear transplantation: Dolly	3	Lecture	Black Board
3.5	Manipulation of reproduction in animals-Transgenic animals	3	Chalk & Talk	PPT
3.6	strategies for gene transfer, Targeted gene transfer, Artificial insemination	3	Chalk &Talk	LCD
3.7	Animal Bioreactor and Molecular Farming, Human gene therapy, Cryobiology	2	Lecture	PPT
UNIT -4 PLANT BIOTECHNOLOGY				
4.1	Introduction to the techniques of plant tissue culture	2	Chalk & Talk	Black Board
4.2	Historical background – Basic requirements for a tissue culture lab – Totipotency	2	Chalk & Talk	LCD
4.3	Requirements for cell and tissue culture - Nutrient media	3	Lecture	PPT
4.4	culture of plant materials - single cell culture,	2	Lecture	Black Board
4.5	Organogenesis: Root and Shoot culture, Micropropagation- Somaclonal variation -	3	Chalk & Talk	Black Board

	Somatic embryogenesis and production of embryoids			
4.6	Haploid and double haploid production - Protoplast isolation and culture	3	Chalk & Talk	LCD
4.7	Somatic hybridization and Cybrid production and their applications in crop improvement	3	Lecture	PPT
4.8	Self-study – GM foods		Discussion	
UNIT -5 REGENERATIVE MEDICINE				
5.1	Current status and application in medicine	3	Chalk & Talk	Black Board
5.2	Application of animal cell culture for *in vitro* testing of drugs;	4	Chalk & Talk	LCD
5.3	Production of recombinant hemoglobin,	4	Lecture	PPT
5.4	blood substituents, Artificial blood, General account of *in vitro* regulation of blood cells production	4	Lecture	PPT
5.5	Bioethics of stem cell research	3	Chalk & Talk	Black Board
5.6	Self-study – Stem cells: Types, isolation umbilical cord blood cells		Discussion	

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1	T2	Seminar	Assignment	OBT/PPT				
	10 Mks.	10 Mks.	5 Mks.	5 Mks	5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	4	4	-	-	-	8	-	8	20 %
K3	2	2	-	5	-	9	-	9	22.5 %
K4	2	2	-	-	5	9	-	9	22.5 %
K5	2	2	5	-	-	9	-	9	22.5 %
Non Scholastic	-	-	-	-	-		5	5	12.5 %
Total	10	10	5	5	5	35	5	40	100 %

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Find the enzymes in rDNA technology	K1	PSO1&PSO3
CO 2	Compare the cloning vehicles with their specific advantages.	K2	PSO1&PSO3
CO 3	Criticize the boon technology of *in-vitro* fertilization	K5	PSO1&PSO8
CO 4	Analyse the technique of tissue culture	K4	PSO2&PSO3
CO 5	Identify the importance of artificial blood	K3	PSO1&PSO3

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	3	2	2	2	2	2	2	2	2	2
CO2	3	2	3	2	2	2	2	2	2	2	2	2
CO3	3	2	2	2	2	2	2	2	2	2	2	2
CO4	2	3	3	2	2	2	2	2	2	2	2	2
CO5	2	2	3	2	2	2	2	2	2	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	2	3
CO4	2	2	3	2
CO5	2	2	3	2

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

1. **Dr. V. Bharathy**
2. **Dr. S. Barathy**

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II M.Sc., ZOOLOGY

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG4Z18	Developmental Biology	Lecture	6	5

COURSE DESCRIPTION

This Course focuses on the developmental process from a single egg to zygote by fertilization, into blastula by Cleavage, followed by Gastrulation into Gastrula. From Gastrula, organ forming rudiments are formed, which give rise to the Organ Systems of the Organism.

COURSE OBJECTIVES

Imparts knowledge on the developmental process from a single egg to foetus, then in an adult.

UNITS

UNIT I: INTRODUCTION TO DEVELOPMENTAL BIOLOGY (15 HRS)

Historical Review and Scope of Embryology; Reproductive Cycles –Regulation; Structure of sperms and eggs - influence of yolk - polarity - symmetry - Egg membranes; Gametogenesis : Migration of Germ cells in Vertebrates, Spermatogenesis and Oogenesis

UNIT II: FERTILIZATION (15 HRS)

Fertilization – Sea Urchin, and Mammals - Approach of the Spermatozoan to the Egg; Reaction of the Egg; Fusion of Gametic Nuclei; Egg Cytoplasm rearrangement by Fertilization; Parthenogenesis.

UNIT III: CLEAVAGE (15 HRS)

Cleavage: Planes of Cell Divisions; Patterns of cleavage; Laws of Cleavage; Cellular Mechanism of Cleavage; Morula and Blastula; Physiology of Cleavage; Products of Cleavage;; Role of Maternal genes during the early Development.

UNIT IV: GASTRULATION (15 HRS)

Gastrulation – Unique features – Gastrula; Morphogenetic movements; Fate maps, Fate of Germinal layers; Axis Formation in Sea Urchin, Fishes, Amphibians, Birds and Mammals; Concept of Spemann's Organizer; Formation of Extra embryonic membranes; Placentation in Mammals

UNIT V: ORGANOGENESIS & POSTEMBRYONIC DEVELOPMENT

(15 HRS)

Development of Central Nervous System, Heart and Lungs; Metamorphosis in Insects, and Amphibians; Teratology; Types of Regeneration, Molecular basis and rôle of Genes on Teratology; Aging and Senescence.

REFERENCE BOOKS:

1. Browder L.N., *Developmental Biology*, Saunders College, Philadelphia (1980).
2. Balinsky B.L., *An Introduction to Embryology*, 5th ed., Saunders Co., Philadelphia (1981).
3. Berrill N.J., *Developmental Biology*, Tata McGraw Hill, New Delhi, (1986).
4. Carlson B.M., *Foundations of Embryology*, Tata McGraw Hill, New Delhi, (2007).
5. Gilbert S.F., *Developmental Biology*, Sinamer Associates Inc. Saunderland, Massachusets, U.S.A. (2003).

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://embryology.med.unsw.edu.au/embryology/index.php/Gastrulation
2. https://teachmeanatomy.info/the-basics/embryology/gastrulation/
3. http://pressbooks-dev.oer.hawaii.edu/biology/chapter/fertilization-and-early-embryonic-development/
4. https://vivaopen.oercommons.org/courseware/lesson/660/overview
5. https://louis.oercommons.org/courseware/module/828/student/?task=4

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 INTRODUCTION TO DEVELOPMENTAL BIOLOGY				
1.1	Historical Review and Scope of Embryology	2	Chalk &Talk	LCD
1.2	Reproductive Cycles –Regulation	4	Chalk & Talk	LCD
1.3	Structure of sperms and eggs - influence of yolk - polarity - symmetry - Egg membranes;	3	Lecture	PPT
1.4	Gametogenesis : Migration of Germcells in Vertebrates, Spermatogenesis and Oogenesis	4	Lecture	PPT

UNIT-2 FERTILIZATION				
2.1	Fertilization – Sea Urchin, and Mammals - Approach of the Spermatozoan to the Egg; Reaction of the Egg; Fusion of Gametic Nuclei;	5	Discussion	Google classroom
2.2	Egg Cytoplasm rearrangementby Fertilization;	3	Specimen	Microscope
2.1	Parthenogenesis.	2	Discussion	Black Board
UNIT-3 CLEAVAGE				
2.1	Cleavage: Planes of Cell Divisions; Patterns of cleavage; Laws of Cleavage	5	Lecture	Green Board Charts
2.2	Cellular Mechanism of Cleavage; Morula and Blastula	2	Chalk & Talk	Green Board
1.1	Physiology of Cleavage	2	Chalk & Talk	Black Board
1.2	Products of Cleavage	2	Chalk & Talk	LCD
1.3	Role of Maternal genes during the early Development	2	Lecture	PPT
UNIT -4 GASTRULATION				
4.1	Gastrulation – Unique features– Gastrula	2	Lecture	Black Board
4.2	Morphogenetic movements; Fate maps	2	Discussion	Google classroom
4.3	Fate of Germinal layers; Axis Formation in Sea Urchin, Fishes, Amphibians, Birds and Mammals	4	Specimen	Microscope
4.4	Concept of Spemann's Organizer	2	Discussion	Black Board
4.5	Formation of Extra embryonic membranes; Placentation in Mammals	3	Lecture	LCD
UNIT-5 ORGANOGENESIS & POST EMBRYONIC DEVELOPMENT				
5.1	Development of Central Nervous System, Heart and Lungs	5	Lecture	LCD
5.2	Metamorphosis in Insects, and Amphibians	3	Lecture	LCD
5.3	Teratology; Molecular basis, Role of Genes on Teratology & Types	3	Lecture	LCD
5.4	Aging and Senescence	2	Lecture	LCD

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	4	4	-	-	-	8	-	8	20 %
K3	2	2	-	5	-	9	-	9	22.5 %
K4	2	2	-	-	5	9	-	9	22.5 %
K5	2	2	5	-	-	9	-	9	22.5 %
Non Scholastic	-	-	-	-	-		5	5	12.5 %
Total	10	10	5	5	5	35	5	40	100 %

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Recalls the basic concepts of Developmental Biology.	**K1**	PSO1& PSO2
CO 2	Explain how fertilization, cleavage and Gastrulation occur.	**K2**	PSO2
CO 3	Compares the basic concepts of organogenesis in different organisms.	**K2**	PSO5
CO 4	Understand the development of egg into a foetus, then into adult.	**K2**	PSO2, PSO11
CO 5	Associate the embryo development with Phylogeny.	**K3**	PSO2, PSO9

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12

CO1	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO5	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**2**	**2**
CO2	**2**	**3**	**2**	**2**
CO3	**2**	**2**	**2**	**3**
CO4	**2**	**2**	**3**	**2**
CO5	**2**	**2**	**2**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

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II M.Sc.,ZOOLOGY

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG4ZE3	Economic Zoology	Lecture	4	4

COURSE DESCRIPTION

The course has great potential for creating self-employment and business opportunity

COURSE OBJECTIVES

- Enable the students to be familiarized with bee keeping, prawn culture, pearl culture, poultry and dairy farming to become an entrepreneur.
- Understand the medicinal value of honey.
- Know to manage and maintain poultry farms.

UNITS

UNIT –I APICULTURE (12 HRS.)

Scope of Apiculture - Morphology of honey bees –species of honey bees: *Apisdorsata*, *Apis indica*, *Apisflorea*, *Apis mellifera*– Social Organization and Life cycle - Behaviour of Honey bees – Bee keeping: Newton's Bee hive - Extraction of honey – Medicinal value of honey – bee products – Importance of bee colonies in crop pollination.

Self-study – Scope of Apiculture -Social Organization and Life Cycle - Behaviour of honey bees – Bee keeping: Newton's Bee hive -Extraction of honey – Medicinal value of honey – bee products.

UNIT –II SERICULTURE (12 HRS.)

Sericulture in India –silk route - Role of Central Silk Board - Different silkworm species and their host plants – Life cycle of Mulberry silkworm &Moriculture- Vegetative Propagation and seeding.Silkworm rearing: Rearing

appliances and Rearing methods–cocoon marketing – raw silk testing – silk waste – economic importance of silk.

Self-study – silk route- Economic importance of silk

UNIT –III PRAWN AND PEARL CULTURE (12 HRS.)

Prawn culture: Types of prawn culture – Culture of fresh water prawn – Culture of marine prawn – Preparation of farm - Preservation and processing of prawn- Export of prawn.

Pearl culture: Types of pearl - Oysters and pearl formation - Composition, colour, size and quality of pearl – culture of pearls.

UNIT –IV POULTRY FARMING (12 HRS.)

Breeds of chick - Housing and Equipment: Deep litter System - Laying cages - Methods of brooding and Rearing –Debeaking - Management of growers, Layers, Broilers – Feed formulations for chicks, Growers and Broilers – vaccination schedule - Nutritive value of egg and meat.

Self-study – Nutritive value of egg and meat

UNIT –V DAIRY FARMING (12 HRS.)

Indigenous and exotic breeds - Rearing – housing – feed and rationing– Commercial importance of dairy farming- Pasteurization of milk – milk products – nutritive value of milk.

Self-study – Pasteurization of milk

REFERENCES:

1. Vasantharaj David, B. and Kumaraswami T., 1998. *Elements of Economic Entomology* Pop. Book Depot. Chennai.
2. Ganga and Sulochana Shetty J.G. (2005)*An introduction to sericulture,* second edition, Oxford & IBH Publishing & Co. Pvt. Ltd., New Delhi.
3. Reddy, S. G., (1994)*Silkworm Breeding*, Oxford & INH Publishing Co Pvt. Ltd., New Delhi.
4. Boraiah, G. (1994)*Lectures on Sericulture*, SBS Publishers distributors, Bangalore.

5. Krishnaswamy S., (1988)*Sericulture Manual* 1, 2 &3, FAO Publications, New Delhi.
6. Jhingran,V.G.,(1975) *Fish and Fisheries of India*, Hindustan publishing corporation, India.
7. Rath, A.K., (2011) *Freshwater Aquaculture*, Scientific publishers, Jodhpr, India.
8. Uma Shankar Singh, (2008) *DairyFarming*,Anmol Publications, New Delhi.
9. ICAR, *Hand book of Animal Husbandry*, The Indian Council for Agricultural Research, New Delhi.
10. N. Nagaraja and D.Rajagopal, (2009).*Honey Bees- Diseases, Parasites, Pests, Predators & their management,* MJP Publishers, Chennai.
11.R. C. Mishra, (1998) *Perspectives in Indian Apiculture,*Agro Botanica, New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6359672/
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4632584/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2748269/
4. https://www.ncbi.nlm.nih.gov/books/NBK232334/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5794767/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 APICULTURE				
1.1	Morphology of honey bees	3	Chalk & Talk	Black Board
1.2	species of honey bees: *Apisdorsata*,	3	Chalk & Talk	LCD
1.3	*Apis indica*, *Apisflorea*, *Apis mellifera*	3	Lecture	PPT
1.4	Importance of bee colonies in crop pollination.	3	Lecture	LCD
1.5	Self-study – Scope of Apiculture - Social Organization and Life Cycle - Behaviour of Honey Bees – Bee keeping: Newton's Bee hive -Extraction of honey – Medicinal value of honey – bee products.		Discussion	
UNIT -2 SERICULTURE				
2.1	Sericulture in India –silk route - Role of Central Silk Board	2	Chalk & Talk	Black Board
2.2	Different silkworm species and their host plants	2	Chalk & Talk	Black Board
2.3	Life cycle of Mulberry silkworm and Moriculture – Vegetative Propagation and seeding	2	Chalk & Talk	LCD
2.4	silkworm rearing: Rearing appliances and Rearing methods	3	Chalk & Talk	Black Board
2.5	cocoon marketing – raw silk testing – silk waste	3	Lecture	Black Board
2.6	Self-study – Silk route - Economic importance of silk		Discussion	
UNIT -3 PRAWN AND PEARL CULTURE				
3.1	Prawn culture: Types of prawn culture	1	Chalk & Talk	Black Board
3.2	Culture of fresh water prawn	1	Lecture	Black Board
3.3	Culture of marine prawn	1	Lecture	Black Board

3.4	Preparation of farm	1	Chalk & Talk	Black Board
3.5	Preservation and processing of prawn- Export of prawn.	2	Lecture	Black Board
3.6	Pearl culture: Types of pearl	1	Chalk & Talk	Black Board
3.7	Oysters and pearl formation	2	Chalk & Talk	Black Board
3.8	Composition, colour, size and quality of pearl	2	Chalk & Talk	Black Board
3.9	culture of pearls	1	Chalk & Talk	LCD
UNIT -4 POULTRY FARMING				
4.1	Breeds of chick	2	Chalk & Talk	LCD
4.2	Housing and Equipment	2	Chalk & Talk	Black Board
4.3	Deep litter System	2	Chalk & Talk	Black Board
4.4	Laying cages - Methods of brooding and Rearing	2	Chalk & Talk	Black Board
4.5	Debeaking - Management of growers, Layers, Broilers - vaccination schedule	2	Chalk & Talk	Black Board
4.6	Feed formulations for chicks, Growers and Broilers	2	Chalk & Talk	PPT
4.7	Self-study – Nutritive value of egg and meat		Discussion	
UNIT -5 DAIRY FARMING				
5.1	Indigenous and exotic breeds	3	Lecture	LCD
5.2	Rearing – housing	3	Chalk & Talk	Black Board
5.3	Feed and rationing	2	Chalk &Talk	Black Board
5.4	Commercial importance of dairy farming	2	Chalk & Talk	Black Board
5.5	milk products - nutritive value of milk	2	Lecture	PPT
5.6	Self-study – Pasteurization of milk		Discussion	

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	4	4	-	-	-	8	-	8	20 %
K3	2	2	-	5	-	9	-	9	22.5 %
K4	2	2	-	-	5	9	-	9	22.5 %
K5	2	2	5	-	-	9	-	9	22.5 %
Non Scholastic	-	-	-	-	-		5	5	12.5 %
Total	10	10	5	5	5	35	5	40	100 %

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Compare the morphological adaptation in bees in relation to their social behaviour.	**K2**	PSO2
CO 2	Plan for a sericulture unit as a cottage industry.	**K3**	PSO4& PSO10
CO 3	Analyse the rearing methods of prawn and pearl oysters.	**K4**	PSO10
CO 4	Summarize the rearing methods of chick.	**K2**	PSO2
CO 5	Assess the commercial importance of dairy farm	**K5**	PSO10

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO4	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO5	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4

CO1	**3**	**2**	**2**	**2**
CO2	**3**	**2**	**2**	**2**
CO3	**2**	**3**	**2**	**2**
CO4	**3**	**2**	**2**	**2**
CO5	**2**	**3**	**2**	**2**

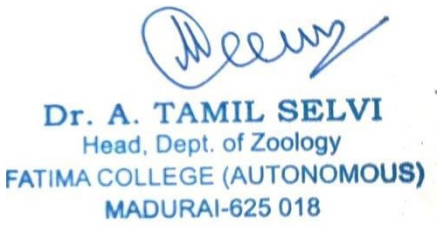
Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

Dr. S. Barathy

Forwarded By



HOD'S Signature & Name

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG4ZE4	Ethology	Lecture	4	4

COURSE DESCRIPTION

Students gain knowledge on learning, behaviour and biorhythm in animal.

COURSE OBJECTIVES

- Acquire fundamental knowledge on the behavioural concept in animals
- Understand the environment, social and reproductive behaviour in animals
- Summarize the phenomenon behind the molecular basis of biological rhythm including circadian.

UNIT –I INTRODUCTION TO ETHOLOGY (12 HRS.)

Introduction -Ethology and Animal psychology. Classification of behavioral patterns: Analysis of behaviour (ethogram) - Reflexes and complex behaviour. Perception of the Environment: Mechanical, Electrical, Chemical, Olfactory, Auditory and Visual. Neural and Hormonal Control of behaviour; Role of nervous system in mergence of behavioural patterns; Role of endocrine secretions in behavioural expressions. Genetic and environmental components in the development of behaviour.

Self - study - Introduction to Ethology and Animal psychology. Perception of the Environment: Mechanical, Electrical, Chemical, Olfactory, Auditory and Visual.

UNIT –II COMMUNICATION AND LEARNING (12 HRS.)

Communication: Importance – types - components and evolution of communication. Role of Visual & auditory systems, hormones & pheromones in communication.Language of communication - invertebrates and vertebrates. Learning and instincts: conditioning, habituation, sensitization, reasoning. Innate releasing mechanisms: key stimuli, stimulus filtering, supernormal stimuli, open and closed IRM, mimetic releaser, code breakers.

Self - study - Communication: Importance

UNIT –III REPRODUCTION AND SOCIAL BEHAVIOUR (12 HRS.)

Reproductive Behavior: Evolution of sex and reproductive strategies, Mating systems, courtship. Sexual selection: intra sexual selection (male rivalry), inter-sexual selection (female choice), infanticide, sperm competition, mate guarding, sexual selection in human, consequences of mate choice for female fitness, monogamous verses polygamous sexual conflict. Social Behavior: Aggregations – Schooling in fishes, flocking in birds, herding in mammals - group selection, kin selection. Altruism – reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call. Social organization in insects.Parental Care in Primates.

Self - study – Primates - Parental care.

UNIT –IV ECOLOGICAL BEHAVIOUR (12 HRS.)

Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression, homing, territoriality, dispersal, host parasite relations.

Homeostasis and behaviour: motivational system, physiological basis of motivation, control of hunger drive in blow fly and thirst drive in goat, role of hormone, motivational conflict and decision making, displacement activity, models of motivation, measuring motivation. Hormones and pheromones influence on behaviour of animals.

UNIT –V CIRCADIUM RHYTHM (12 HRS.)

Biological Rhythms: Circadian and Circannual rhythms, Orientation and navigation: Migration of fish and birds. Molecular Genetics of

Circadian Rhythms- the regulation of biological clock-sleep and awake in man.Sleepingdisorders - medical diagnosis and therapy. Chronopharmacology, Chronomedicine, Chronotherapy.

Self study – Migration of fish and birds

UNIT –VI DYNAMISM (Evaluation Pattern-CIA only) (HRS.)

REFERENCES:

1. Agarwal V.K. (2010). *Animal Behaviour* (Ethology). S. Chand Publishers.
2. Insect Clocks D.S., Saunders C.G.H., Steel X., Afopoulou (ed.) R.D. Lewis. (3rd Ed) 2002 Barens and Noble Inc. New York, USA.
3. Vinod Kumar (2002). *Biological Rhythms* .Narosa Publishing House, Delhi/ Springer-Verlag, Germany
4. Jay C. D., Jennifer J., Loros, Patricia J. DeCoursey (ed). (2004). *ChronobiologyBiological Timekeeping*: Sinauer Associates, Inc.Publishers, Sunderland, MA, USA
5. Saunders D.S., Steel C.G.H. (2002). *Insect Clocks*Afopoulou (ed.)R.D. Lewis. (3rdEd) Barens and Noble Inc. New York, USA
6. Manning A. and Dawkins M.S, (2012). *An Introduction to Animal Behaviour*, Cambridge, University Press, UK.
7. John A. (2001). *Animal Behaviour*, Sinauer Associate Inc., USA. 7th Ed.
8. Paul W. S and John A. (2013). *Exploring Animal Behaviour*, Sinauer Associate Inc., Massachusetts, USA. 6th Ed.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.oercommons.org/authoring/2459-conditioning-animals-learning-behaviour-ecology-en/view
2. https://www.oercommons.org/browse?f.keyword=animal-behaviour
3. https://www.psychologytoday.com/intl/basics/animal-behavior
4. https://seaworld.org/animals/all-about/training/animal-behavior-and-learning/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
UNIT -1 INTRODUCTION TO ETHOLOGY				
1.1	Introduction -Ethology and Animal psychology.	1	Chalk & Talk	Black Board
1.2	Classification of behavioral patterns	2	Chalk & Talk	LCD
1.3	Analysis of behaviour (ethogram) - Reflexes and complex behaviour.	2	Lecture	PPT & White board
1.4	Self Study: Perception of the Environment: Mechanical, Electrical, Chemical, Olfactory, Auditory and Visual.	-	Discussion	LCD
1.5	Neural and Hormonal Control of behaviour; Role of nervous system in mergence of behavioural patterns;	3	Lecture	Black Board
1.6	Role of endocrine secretions in behavioural expressions.	2	Chalk & Talk	Black Board
1.7	Genetic components in the development of behaviour	1	Lecture	PPT & White board
1.8	Environmental components in the development of behaviour.	1	Discussion	Black Board
UNIT -2 COMMUNICATION AND LEARNING				
2.1	Communication: Importance – types - components and evolution of communication.	1	Lecture	Green Board Charts

2.2	Role of Visual & auditory systems in communication.	2	Chalk & Talk	Green Board
2.3	Role of hormones & pheromones in communication	2	Chalk & Talk	Black Board
2.4	Topic: Language of communication	1	Chalk & Talk	Black Board
2.5	Sub topics: Invertebrates and vertebrates.	2	Lecture	PPT & White board
2.6	Learning and instincts: conditioning, habituation, sensitization, reasoning.	2	Lecture	Green Board
2.7	Topic: Innate releasing mechanisms	1	Chalk & Talk	Green Board
2.8	Sub topics: key stimuli, stimulus filtering, supernormal stimuli, open and closed IRM, mimetic releaser, code breakers.	2	Chalk & Talk	Black Board
UNIT -3 REPRODUCTION AND SOCIAL BEHAVIOUR				
3.1	Reproductive Behavior:	1	Chalk & Talk	Black Board
3.2	Evolution of sex and reproductive strategies, Mating systems, courtship		Chalk & Talk	Black Board
3.3	Sexual selection: intra sexual selection (male rivalry), inter-sexual selection (female choice), infanticide, sperm competition, mate guarding, sexual selection in human, consequences of mate choice for female fitness, monogamous verses polygamous sexual conflict.		Lecture	PPT & White board

3.4	Social Behavior: Aggregations – Schooling in fishes, flocking in birds, herding in mammals – group selection, kin selection.		Lecture	PPT
3.5	Altruism – reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call.		Chalk & Talk	Black Board
3.6	Social organization in insects.		Lecture	Group Discussion
3.7	Self – study – Primates – Parental care.		Lecture	PPT & White board
UNIT – 4 ECOLOGICAL BEHAVIOUR				
4.1	Ecological aspects of behaviour	1	Lecture	PPT & White board
4.2	Sub topics: Habitat selection, food selection, optimal foraging theory,	2	Chalk & Talk	LCD
4.3	Sub topics: anti-predator defenses, aggression, homing, territoriality, dispersal, host parasite relations.	2	Chalk & Talk	Black Board
4.4	Homeostasis and behaviour	1	Chalk & Talk	Black Board
4.5	Sub topics: motivational system, physiological basis of motivation, control of hunger drive in blow fly and thirst drive in goat, role of hormone, motivational conflict and	4	Chalk & Talk	PPT

	decision making, displacement activity, models of motivation, measuring motivation.			
4.6	Hormones and pheromones influence on behaviour of animals.	2	Chalk & Talk	LCD
UNIT -5 CIRCADIUM RHYTHM				
5.1	Biological Rhythms: introduction	1	Chalk & Talk	Black Board
5.2	Circadian and Circannual rhythms,	2	Chalk & Talk	LCD
5.3	Orientation and navigation: Migration of fish and birds.	1	Discussio n	Black Board
5.4	Molecular Genetics of Circadian Rhythms- the regulation of biological clock-sleep and awake in man.	4	Lecture	PPT & White board
5.5	Sleeping disorders - medical diagnosis and therapy	2	Lecture	PPT & White board
5.6	Chronopharmacology, Chronomedicine, Chronotherapy.	2	Chalk & Talk	Black Board

EVALUATION PATTERN

Internal

Levels	C1	C2	C3	C4	C5	Total Scholastic Marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 10 Mks.	T2 10 Mks.	Seminar 5 Mks.	Assignment 5 Mks	OBT/PPT 5 Mks	35 Mks.	5 Mks.	40Mks.	
K2	4	4	-	-	-	8	-	8	20 %
K3	2	2	-	5	-	9	-	9	22.5 %
K4	2	2	-	-	5	9	-	9	22.5 %
K5	2	2	5	-	-	9	-	9	22.5 %
Non Scholastic	-	-	-	-	-		5	5	12.5 %
Total	10	10	5	5	5	35	5	40	100 %

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

EVALUATION PATTERN

SCHOLASTIC					NON - SCHOLASTIC	MARKS		
C1	C2	C3	C4	C5	C6	CIA	ESE	Total
10	10	5	5	5	5	40	60	100

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Classify different patterns of genetic, environmental, neural and hormonal animal behaviour	**K4**	PSO2, PSO4 & PSO5, PSO11
CO 2	Explains the role of visual, auditory communication with respect to learning and instincts mechanism	**K5**	PSO2, PSO5 & PSO11
CO 3	Discuss the various reproductive and social behaviours in context to pair selection.	**K6**	PSO2, PSO5 & PSO11
CO 4	Summarizes the ecological condition such as hunger, thirst, territories etc., in influencing the animal behaviour.	**K2**	PSO2, PSO4 PSO5, PSO8, PSO11
CO 5	Elaborate the molecular regulation of circadian rhythm	**K6**	PSO1, PSO2, PSO5 & PSO11

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO2	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO3	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**
CO4	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**2**
CO5	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	2	3	1	2
CO2	2	3	1	2
CO3	2	3	1	2
CO4	1	3	1	1
CO5	1	3	1	1

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**

□ Weakly Correlated -**1**

COURSE DESIGNER:

Dr. N. Nagarani

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II M.Sc., ZOOLOGY

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	19PG4Z19	Lab in Environmental Biology & Developmental Biology	Practical	4	2

COURSE DESCRIPTION

This course provides knowledge about the relationship between organisms and their environment. It also helps to learn about development of organisms.

COURSE OBJECTIVES

- Enable the students to estimate the physico-chemical parameters of soil and water.
- Observe the different developmental stages of chick embryo and record it.
- Understand the life cycle of *Drosophila melanogaster* by rearing them and record the observation.

UNITS

ECOLOGY

1. Study of Pond/ River ecosystem - Food web and food chain
2. Determination of chlorides in soil
3. Estimation of Primary Productivity
4. Estimation of pH of soil
5. Estimation of soil organic carbon
6. Estimation of alkalinity of soil
7. Estimation of alkalinity of water
8. Quantitative estimation of salinity, phosphates and nitrates in water samples.
9. Estimation of Biological Oxygen Demand (BOD).
10. Identification of Planktonic organisms.
11. Observation of species using quadrat method

FIELD STUDY REPORT

12. Visit to Pollution Control Board

DEVELOPMENTAL BIOLOGY

13. Identification of chick embryo developmental stages – 24hrs, 48hrs, 72hrs, &96hrs.
14. Study of life cycle of *Drosophila melanogaster*.
15. Contraceptive devices.
16. Placenta of goat.

REFERENCES:

1. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) *Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.*
2. Rajan S., Christy, S.R., (2011) *Experimental procedures in Life Sciences, Anjana Book House, Chennai.*

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5131676/
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2562489/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4454838/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5552271/
5. https://www.ncbi.nlm.nih.gov/books/NBK10070/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
ECOLOGY				
1	Study of Pond/ River ecosystem - Food web and food chain	4	Demonstration	
2	Determination of chlorides in soil	4	Demonstration & hands on training	Soil
3	Estimation of Primary Productivity	4	Demonstration & hands on training	Pond water
4	Estimation of pH of soil	4	Demonstration & hands on training	Soil
5	Estimation of soil organic carbon	4	Demonstration & hands on training	Soil
6	Estimation of alkalinity of soil	4	Demonstration & hands on training	Soil

7	Estimation of alkalinity of water	4	Demonstration & hands on training	Water
8	Quantitative estimation of salinity, phosphates and nitrates in water samples	4	Demonstration & hands on training	Water
9	Estimation of Biological Oxygen Demand (BOD).	4	Demonstration & hands on training	Water
10	Identification of Planktonic organisms.	4	Demonstration & hands on training	Pond water
11	Observation of species using quadrat method	4	Demonstration & hands on training	
12	**Field Study Report** Visit to Pollution Control Board			
DEVELOPMENTAL BIOLOGY				
13	Identification of chick embryo developmental stages – 24hrs, 48hrs, 72hrs, &96hrs.	4	Demonstration	Hen's egg
14	Study of life cycle of *Drosophila melanogaster*.	4	Hands on training	Ripened fruits
15	Contraceptive devices.	4	Explanation	
16	Placenta of goat.	4	Demonstration	Specimen

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

Evaluation Pattern

MARKS		
CIA	**ESE**	**Total**
40	**60**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Find the primary productivity	K1	PSO3
CO 2	Demonstrate the estimation of various components of soil and water.	K2	PSO3 & PSO6
CO 3	Identify the zoo planktons in water sample.	K3	PSO3 & PSO4
CO 4	Analyse the various developmental stages of chick embryo.	K4	PSO3
CO 5	Compare the diversity of species by quadrat method.	K5	PSO2 & PSO3

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	2	2	3	2	2	2	2	2	2	2	2	2
CO2	2	2	3	2	2	2	2	2	2	2	2	2
CO3	2	2	3	2	2	2	2	2	2	2	2	2
CO4	2	2	3	2	2	2	2	2	2	2	2	2
CO5	2	3	3	2	2	2	2	2	2	2	2	2

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	3	3	2	2
CO2	2	3	2	2
CO3	2	3	2	2
CO4	2	3	2	2
CO5	3	3	2	2

Note: Strongly Correlated – **3** Moderately Correlated – **2**
 Weakly Correlated -**1**

COURSE DESIGNER:
Dr. S. Barathy

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II M.Sc., ZOOLOGY

SEMESTER –IV

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	**19PG4Z20**	**Lab in Biotechnology, Economic Zoology & Ethology**	**Practical**	**4**	**2**

COURSE DESCRIPTION

This course provides rich knowledge in isolating DNA from different sources. It also helps to observe the behavioural pattern of selected animals.

COURSE OBJECTIVES

- Students acquire hands on experience in using lab equipment.
- Gain knowledge in tissue culture and micropropagation techniques.
- Enable the students to know about chasing behaviour in fish.

UNITS

Biotechnology

1. Biosafety guidelines

2. Plant tissue culture techniques: Preparation of MS media, callus Micropropagation techniques
3. Isolation of genomic DNA from goat liver
4. Isolation of plasmid DNA from bacteria
5. DNA estimation using diphenylamine method
6. Restriction enzymes digestion of DNA.
7. Separation of DNA using Agarose gel electrophoresis.
8. Demonstration of PCR techniques.
10. Elution of DNA from Gel

Economic zoology

11. Visit of silk farms and silk reeling weaving units in nearby areas and submission of the report.

12.Observation of larval stages of Prawn.

13.Newton's Bee hive.
14.Feeder

Ethology

15.A field study of foraging or trail making behaviour in ant species.
16.Study of nest building behaviour in birds.
17.Study of habitat selection in spiders.
18.Chasing behaviour in fish.

REFERENCES:

1. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) *Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.*
2. Rajan S., Christy, S.R., (2011) *Experimental procedures in Life Sciences, Anjana Book House, Chennai.*

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.youtube.com/watch?v=nr1tV_LuqJk
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3395714/
3. https://www.ncbi.nlm.nih.gov/probe/docs/techpcr/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6617107/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242575/

COURSE CONTENTS & LECTURE SCHEDULE:

Module No.	Topic	No. of Lectures	Teaching Pedagogy	Teaching Aids
BIOTECHNOLOGY				
1	Biosafety guidelines	4	Lecture	

2	Plant tissue culture techniques: Preparation of MS media, callus formation.	4	Demonstration & hands on training	Plant
3	Micropropagation techniques	4	Demonstration & hands on training	
4	Isolation of genomic DNA from goat liver	4	Demonstration & hands on training	Goat liver
5	Isolation of plasmid DNA from bacteria	4	Demonstration & hands on training	Bacterial culture
6	DNA estimation using diphenylamine method	4	Demonstration & hands on training	Isolated DNA
7	Restriction enzymes digestion of DNA.	4	Demonstration & hands on training	Isolated DNA
8	Separation of DNA using Agarose gel electrophoresis	4	Demonstration & hands on training	Isolated DNA
9	Demonstration of PCR techniques	4	Demonstration	
10	Elution of DNA from Gel	4	Demonstration & hands on training	Isolated DNA
ECONOMIC ZOOLOGY				
11	Visit of silk farms and silk reeling weaving units in nearby areas and submission of the report.	4	Demonstration	
12	Observation of larval stages of Prawn	4	Demonstration	Slides
13	Newton's Bee hive.	4	Demonstration	Model
14	Feeder	4	Demonstration	Model
ETHOLOGY				
15	A field study of foraging or trail making behaviour in ant species	4	Demonstration	Nature Observation
16	Study of nest building behaviour in birds	4	Demonstration	Nature Observation
17	Study of habitat selection in spiders	4	Demonstration	Nature Observation
18	Chasing behaviour in fish	4	Demonstration	Nature Observation

CIA

Scholastic	**35**
Non Scholastic	**5**
	40

Evaluation Pattern

MARKS		
CIA	**ESE**	**Total**
40	**60**	**100**

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Demonstrate the plant tissue culture technique.	**K2**	PSO3
CO 2	Experiment with DNA isolation	**K3**	PSO3
CO 3	Estimate DNA quantitatively	**K5**	PSO3
CO 4	Analyse Newton's bee hive	**K6**	PSO2
CO 5	Relate nest building in different birds	**K1**	PSO2

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12

CO1	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO5	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**2**	**2**	**3**	**2**
CO2	**2**	**3**	**2**	**2**
CO3	**2**	**3**	**2**	**2**
CO4	**3**	**2**	**2**	**2**
CO5	**2**	**3**	**2**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**
□ Weakly Correlated -**1**

COURSE DESIGNER:

1. **Dr. S. Barathy**

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I M.Sc.ZOOLOGY

SEMESTER –I

For those who joined in 2021 onwards

Discipline Specific Self Learning Course

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	21PG2ZSL	Fermentation Technology	Tutorial	-	2

COURSE DESCRIPTION

This course deals with culturing microorganisms on a large scale to produce valuable commercial products.

COURSE OBJECTIVES

- To empower the students with various designs of fermentor.
- To enable the students understand the fermentation process to manipulate microbes for improvement.

UNITS

UNIT –I INTRODUCTION

History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms – primary and secondary

screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.

UNIT –II BIOREACTORS

Basic concepts for selection of a reactor, Types- Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor, Waldhof, Tower, Deep jet, Cyclone column, Packed tower and airlift fermenter, Membrane reactor, Photo bioreactor, Solid state fermenter.

UNIT –III TYPES OF CULTURE

Criteria for transfer of inoculum for bacteria, yeast and mycelia; aseptic methods of inoculation, media components - Role of buffers, antifoaming agents, aeration, and agitation. Microbial growth kinetics, Types of culture - Batch culture, Continuous Culture, Fed – Batch.

UNIT –IV PROCESSING AND RECOVERY OF PRODUCTS

Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two-phase separation, solvent extraction, chromatography and electrophoresis.

UNIT –V PRODUCTS OF FERMENTATION TECHNOLOGY

Fermentation processes for production of Single cell protein SCP, enzymes, alcohol, vitamin-B1, amino acids- glutamic acid, organic acid- citric acid, Antibiotic- penicillin, Bioprocess economics and bioproduct regulation.

UNIT –VI DYNAMISM(For CIA only)

REFERENCES:

1. Arnold L. Demain& Julian E. Davis. Industrial Microbiology & Biotechnology, ASM Press (2004).
2. Coulson, J.M. and J.F. Richardson; 6th Edition, Chemical Engineering Elsevier. McGraw Hill Publication. (1999).
3. Shuler, M. L. and F. Kargi., (2002). Bioprocess Engineering Basic Concepts, 2nd ed., Prentice Hall, Upper Saddle River, NJ,
4. Daniel I. C., et al., (1979)"Fermentation and Enzyme Technology," John Wiley, New York .
5. Willey, J. M. Shrewood, L. M. (2008) Microbiology .7th ed. McGraw Hill.,1067-1069
6. Peter F Stanbury, Allan Whitaker, Stephen J Hall. *Principles of Fermentation Technology.* (2016) Butterworth-Heinemann Press. UK.

7. H. J. Peppler, D. Perlman. *Microbial Technology: Fermentation Technology.* (2014). Academic Press.
8. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. *Fermentation Microbiology and Biotechnology*. Second Edition. (2006). CRC Press, USA.
9. Hongzhang Chen. *Modern Solid State Fermentation: Theory and Practice.* (2013). Springer Press, Germany.
10. John E. Smith. *Biotechnology*. (2009). Cambridge University Press.UK.
11. Celeste M. Todaro, Henry C. Vogel. *Fermentation and Biochemical Engineering Handbook*. (2014). William Andrew Press. Norwich, NY.
12. G. Lancini, R. Lorenzetti. *Biotechnology of Antibiotics and other Bioactive Microbial Metabolites*. (2014). Springer publications, Germany.

DIGITAL OPEN EDUCATIONAL RESOURCES (DOER):

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=83424&section=2.3
2. https://www.oercommons.org/search?f.search=Fermentation+technology
3. https://openlab.citytech.cuny.edu/bio-oer/cellular-energy/fermentation/
4. http://uilis.unsyiah.ac.id/oer/items/show/4191
5. https://www.biotechnologynotes.com/amino-acids/industrial-production-of-amino-acids-by-microorganism-and-fermentation/13820#:~:text=Of%20the%20various%20amino%20acids,of%20these%20two%20amino%20acids.&text=Apart%20from%20fermentative%20processes%2C%20some,quite%20economically%20by%20chemical%20processes.

EVALUATION PATTERN

Internal	External
Assignment – 20 Marks Test – 20Marks	Objective – 20 Marks Essay Type Qns. – 40 Marks
Total – 40Marks	Total – 60Marks

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Recall the history and scope of fermentation process	**K2**	PSO 1
CO 2	Differentiate the types of fermentors	**K4**	PSO 1
CO 3	Analyse kinetics of cell and product formation in batch, continuous and fed-batch cultures	**K4**	PSO 3
CO 4	Identify different industrial processes involved in product recovery	**K3**	PSO 9
CO 5	Evaluate the applications and products of fermentation technology	**K5**	PSO 9

Mapping of COs with PSOs

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**
CO5	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

Mapping of COs with POs

CO/ PSO	PO1	PO2	PO3	PO4
CO1	**3**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**2**

Note: □ Strongly Correlated – **3** □ Moderately Correlated – **2**
□ Weakly Correlated -**1**

COURSE DESIGNER:
Mrs. J .Thelma

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II M.Sc., ZOOLOGY

SEMESTER –IV

SELF-LEARNING PAPER

(For those who joined in 2021 onwards)

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
PSZO	21PG4ZSL	Vector Borne Diseases	Self Learning	-	2

COURSE DESCRIPTION

The course intends to provide the epidemiology, causes, symptoms, lifecycle of causative agent and prevention of various vector-borne diseases.

COURSE OBJECTIVES

- To understand the biology of vectors and host-vector interactions

- To envisage the environmental factors associated with disease prevalence.

UNITS

UNIT I – *AEDES* MOSQUITOES

Identification of *Aedesaegypti* and *Aedesalbopictus* – epidemiology, Causes, transmission cycle - clinical symptoms, prevention and control measures of Chikungunya, Dengue fever, Yellow fever, Zika virus.

UNIT II – *ANOPHELES* AND *CULEX* MOSQUITOES

Epidemiology, Causes, clinical symptoms, life cycle of causative agent, prevention and control measures of Malaria, Japanese encephalitis, Lymphatic filariasis, West Nile fever.

UNIT III – OTHER VECTORS

Biology of Sandflies – Leishmaniasis – Biology of Ticks – Crimean-Congo haemorrhagic fever – Biology of Tsetse fly – African trypanosomiasis- Scrub Typhus.

UNIT IV - PREVENTION AND CONTROL

Long-lasting insecticidal nets – indoor residual spraying – outdoor spraying – Environmental management: Reduce breeding habitats – biological control, genetic control – Waste management – Housing modifications – personal protection – medication – prophylaxis and preventive therapies

UNIT V – ENVIRONMENTAL FACTORS

Deforestation - Agriculture and animal husbandry - Water control projects - Urbanization - Loss of biodiversity -. Introduction of alien species - Climate change - Anthropogenic factors driving climate change – Direct climate change effects – indirect climate change effects.

REFERENCES

1. A global brief on Vector-borne diseases (2014), WHO, WHO Press, World Health Organization, Geneva, Switzerland.

2. Vector Borne Diseases: Prevention, Treatment and control, Disease Prevention and Outbreak Response Cell (DPORC), Centre for Community Medicine, All India Institute of Medical Sciences, New Delhi

3. Benelli, G. and Mehlhorn H. (2018) *Mosquito-borne Diseases Implications for Public Health*, Springer Nature Publications, USA.

4. Tyagi BK. (2019) *Vector-Borne Diseases: Epidemiology and Control* Scientific Publishers, India.

5. Institute of Medicine. 2008. Vector-Borne Diseases: Understanding the Environmental, Human Health, and Ecological Connections: Workshop Summary. Washington, DC: The National Academies Press.

Digital Open Educational Resources (DOER)

1. https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases
2. http://publichealth.lacounty.gov/acd/vector.htm#:~:text=Vector%2DBorne%20Disease%3A%20Disease%20that,%2C%20Lyme%20disease%2C%20and%20malaria.
3. https://nvbdcp.gov.in/

EVALUATION PATTERN

Internal	External
Assignment – 20 Marks Test – 20Marks	Objective – 20 Marks Essay Type Qns. – 40 Marks
Total – 40Marks	Total – 60Marks

COURSE OUTCOMES

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

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED	PSOs ADDRESSED

		BLOOM'S TAXONOMY)	
CO 1	Describe the biology and lifecycle of various vectors	**K1**	PSO1
CO 2	Discuss the genome and proteins of virus transmitted by vectors	**K2**	PSO1
CO 3	Relate the environmental factors that increase the prevalence of vector borne diseases	**K3**	PSO6, PSO7
CO 4	Summarize the various vector control methods and prevention of the disease	**K2**	PSO1
CO 5	Examine the anthropogenic factors that cause high incidence of vector-borne disease	**K1**	PSO6, PSO7

COURSE DESIGNER:

1. **Dr. J. Asnet Mary**

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