GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to university of Madras and Accredited at A++ Grade By NAAC)

Guru Nanak Salai, Velachery, Chennai - 600042

SCHOOL OF SCIENCES

M.Sc., ZOOLOGY

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the PG Batch of 2024-26 and thereafter)

LOCF - LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

Preamble

1. About the Programme

M.Sc., Zoology is a degree programme whose curriculum involves different functions, forms, and behavior of animal species which is used as an application to understand the biological principles of animals and derive result proof observations. This degree programme is well structured and provides students hands-on experience for understanding different concepts related to zoology and animal science. After the completion of M.Sc., Zoology, candidates have various options from working as a professional to studying as a research student. The course has different levels of opportunities in terms of higher education. Some of the most popular areas in zoology are animal behaviors and neurology, ecology and evolutionary biology, marine biology, genetics, biomedical science, and more. Candidates who wish to move towards the research side of zoology must consider pursuing a Ph.D., since it offers great research opportunities that might help students dive deeper into the research area of zoology. The degree programme offers different types of career development options which can be easily accessed by students when looking for career opportunities. Some of the most popular career options when it comes to M.Sc., zoology graduates are wildlife conservation, ecosystem monitoring, environment management, animal diversity prospecting, and more. Candidates also have the opportunity to work as zoologists in pharmaceutical companies. Research associate is also a popular career option among M.Sc., Zoology students. Apart from working in the industry, candidates can also choose to work as a lecturer or professor in colleges or universities.

Zoologist: A zoologist is a professional who is responsible for conducting research and studies on different animal species. A zoologist is responsible for studying the evolution, origin, behaviors, diseases, and life cycles of the animals.

Research Associate: A research associate is a professional who is responsible for conducting extensive research in the field of zoology involving certain specializations such as animal behavior, animal reproduction, animal genetics, and more.

Technical Officer in Aquaculture: Maintenance and monitoring of aquaculture pond, cage or net pen, raceway, and recirculating systems. Preparation of seafood products, feed formulations in shrimp, crab and fish culture division.

Taxonomist in Biodiversity: It involves, Census of wildlife animals, Remote sensing, Geo Tagging, Conservation, Species identification etc., in biosphere reserve areas.

2. Vision

To instill the scientific dogmas of nature; to provoke the interest towards learning science and allied subjects; to equip the students with scientific skills to acquire competency needed for employment; to inculcate professional ethics and value-based education to improve socio-economic status; to impart interdisciplinary approach for identifying and solving real world scientific problems through research.

3. Mission

1. To facilitate an encouraging and exciting environment to develop the scientific temper in students through a curriculum based on fundamental as well as advanced scientific knowledge.
2. To provide technical skills in the respective disciplines through conducting practical training including internship as well as project, this will hone the skills necessary to become a successful mathematician, physicist, chemist, biotechnologist and visual communication professional.
3. To inculcate interdisciplinary knowledge, elective subjects in various fields are offered, thereby providing an opportunity to the students to identify their interest towards a particular field and pursue the passion.

4. Program Educational Outcomes (PEOs)

PEO1: Values of Life, Ethics & Social Concern

The graduates exhibit truth, loyalty, and love as integral moral principles, thereby contributing to a society characterized by enhanced well-being and fundamental goodness in behavior.

PEO2: Employability & Entrepreneurship

The graduates apply analytical, logical, and critical problem-solving skills in professional contexts, elevating employability and cultivating entrepreneurial capabilities through upskilling.

PEO3: Regional/National/Global Relevance & Competency

The graduates foster advanced analytical skills and a heightened appreciation for current Regional/National/Global perspectives, enabling informed and sustainable decision-making in a dynamic environment.

PEO4: Skill Enhancement, Self-Directed & Lifelong Learning

The graduates independently engage in skill-based learning, utilizing infrastructure and opportunities for continuous upskilling, enabling self-evaluation and lifelong excellence attainment.

PEO5: Research Skills & Innovation

The graduates proficiently apply scientific reasoning, fostering creativity, strategic thinking, and effective problem-solving skills. They demonstrate a core competency in generating innovative ideas for advancements and inventions.

5. Program Outcomes (POs)

PO1: Enriched knowledge to solve complex problems and develop scientific temper.

PO2: Advanced knowledge in inter/multi-disciplinary aspects.

PO3: Integrated self-learning through project works, co-curricular activities, industrial exposure and field trainings.

PO4: Resilient moral and ethical values for becoming a responsible citizen.

PO5: Comprehend concepts of sustainability for scientific and technological progress.

6. Program Specific Outcomes (PSOs)

PSO 1: Students will be able to understand and enrich their knowledge on biodiversity, systematic position, environmental relationship, phylogenetic interaction, cellular and biochemical constituents of animal kingdom.

PSO 2: Practice the perception of biological applications and technology to promote the traditional and modern methods for solving the complex problems in animal biology.

PSO 3: Integrating experiential learning opportunities in academia and industries with appropriate techniques, there by enriching the critical thinking in the multidisciplinary areas of life sciences.

PSO 4: Students will be able to enrich their knowledge and skill to inculcate in animal research; to communicate effectively with stakeholders and contribute towards the national priorities as entrepreneurs.

PSO 5: To develop scientific approach and effective problem-solving skills with strategic thinking for fostering creativity and innovation in research areas.

7. PEO – PO mapping

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PO 1	3	3	3	3	3
PO 2	2	3	3	3	3
PO 3	2	3	3	3	3
PO 4	2	3	3	3	3
PO 5	3	3	3	3	3

8. PO – PSO mapping

	PO 1	PO2	PO3	PO4	PO5
PSO 1	3	2	2	1	1
PSO 2	3	3	3	3	3
PSO 3	3	3	3	3	3
PSO 4	3	3	3	3	3
PSO 5	3	3	3	3	3

9. Choice Based Credit System (CBCS)

The College follows the CBCS with Grades under the Semester pattern. Each course is provided with a credit point based on the quantum of subject matter, complexity of the content and the

hours of teaching allotted. This is done after a thorough analysis of the content of each subject paper by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job oriented Elective, Multidisciplinary skill-based courses as part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience.

Eligibility for Admission

Candidates admitted to the first year of the UG programme should have passed the higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

Duration of the Course

The UG programme is of three years duration with six semesters and the PG programme is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students appear for the final End Semester Exam.

Course Structure

The M.Sc., programme has 15 core courses with 4 credits each, 6 elective courses including 2 Extra Disciplinary courses with 3 credits, 4 Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits. Project with 5 credits and 2 credits for Extension activity.

Internship training is a compulsory component for all the UG & PG programmes.

10. Consolidated Credit Structure for all the 2 years

	No. of Paper	Credits
Core (Including Practical)	15	60
Elective	6	18
Soft Skills	4	8
Internship	1	2
Project	1	5
Extension activity	-	2
Total		95

11. Credit Distribution for Each Semester

Sem	Part	Subjects	Credits	Hours	Internal	External	Total
I	Core Paper - 1	Functional Morphology and Phylogeny of Invertebrata	4	4	50	50	100
	Core Paper - 2	Cell and Molecular Biology	4	4	50	50	100
	Core Paper - 3	Genetics	4	4	50	50	100
	Core practical - 1	Invertebrata, Cell & Molecular Biology, Genetics and Fishery Biology	4	12	50	50	100
	Elective Paper - 1	Fishery Biology	3	4	50	50	100
	SoftSkill-1	Communication and Presentation Skills	2	2	*	*	100
		Total	**21**	**30**			
II	Core Paper - 4	Functional Morphology and Phylogeny of Chordata	4	4	50	50	100
	Core Paper - 5	Animal Physiology	4	4	50	50	100
	Core Paper - 6	Immunology	4	4	50	50	100
	Core practical - 2	Chordata, Animal Physiology, Immunology, and Entomology	4	10	50	50	100
	Elective Paper - 2	Economic Entomology and Pest Management	3	3	50	50	100
	EDE-1	**Wildlife Management**	3	3	50	50	100
	Soft Skill-2	Personality Enrichment	2	2	*	*	100
		Total	**24**	**30**			
III	Core Paper - 7	Developmental Biology	4	4	50	50	100
	Core Paper - 8	Environmental Biology	4	4	50	50	100
	Core Paper - 9	Evolution and Animal Behavior	4	4	50	50	100
	Core practical - 3	Practical: Developmental Biology and Environmental Biology, Microbiology and Evolution	4	10	50	50	100
	Elective Paper - 3	Applied Zoology and Microbiology	3	3	50	50	100
	EDE-2	**Public Health and Hygiene**	3	3	50	50	100
	Soft Skill - 3	Employability Skills	2	2	50	50	100
		Internship	2	*	*	100	100
		Total	**26**	**30**			
IV	Core Paper - 10	Research Methodology and Biostatistics	4	4	50	50	100
	Core Paper - 11	Biochemistry and Medical Lab Technology	4	4	50	50	100
	Core practical - 4	Practical – Biochemistry, Medical Lab Technology, Biostatistics and Research Methodology	4	12	50	50	100

	Elective Paper - 4	Genetic Engineering and Biotechnology	3	4	50	50	100
	Core Paper - 12	Project	5	4	*	*	100
	Soft Skill - 4	Advanced Computing Paradigms	2	2	*	*	100
		Total	**22**	**30**			
		Total Credits	**93**				

Examination

Continuous Internal Assessment (CIA) will be for 50 percent and

End Semester Examination (ESE) will be for 50 percent.

Continuous Internal Assessment (CIA)

Every semester will have a mid-semester examination which will be conducted on completion of 45 working days in each semester. A Model exam for three hours duration will be conducted on completion of 80 working days in each semester. For the courses coming under Part IV, ESE will be conducted in MCQ pattern. Internship credits will be given in semester V after verification of documents by the respective Heads.

The schedule for these tests is as follows:

CIA	Schedule	Syllabus Coverage
Mid Semester Examination	After **45** working days of the Semester	60%
Model Examination	After **80** working days of the Semester	95%

The components for the CIA (Theory & Practical's) are as follows:

Internal Components			
Assessment Type	**Nature**	**Maximum Marks**	**% of Weightage**
CIA	Mid Semester Examination	50	10
Model	Model Examination	100	10
	Assignment		10
	Class activities		15
	Attendance		5
Total			50

The class activity relates to a programme of accepted innovative techniques such as Seminar, Quiz, Portfolio creation, PowerPoint presentation, Objective tests, Role play, Group discussion, Case Study etc. The mode of evaluation of the class activity will be fixed before the commencement of

the semester and an approval will be obtained from the Head of the programme/wing. The students will be informed of the various methods of evaluation once the semester begins.

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking. CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty. The marks for attendance will be awarded as per the following:

% of General Attendance	Marks Awarded
90-100	5
75-89	4
60-74	3
<60	0

End Semester Examinations (ESE)

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG programmes will be held for all courses in November/December and April/May. Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practical's will be notified by the Controller of Examinations in consultation with the Dean (Academics)

12. Mode of Evaluation

<table>
<tr><td colspan="3">METHODS OF EVALUATION</td></tr>
<tr><td rowspan="5">Internal Evaluation</td><td>Mid Sem Exam (10)</td><td rowspan="5">50 Marks</td></tr>
<tr><td>Model Exam (10)</td></tr>
<tr><td>Assignment (10)</td></tr>
<tr><td>Class activity (15)</td></tr>
<tr><td>Attendance (5)</td></tr>
<tr><td>External Evaluation</td><td>End Semester Examination</td><td>50 Marks</td></tr>
<tr><td colspan="2">Total</td><td>100 Marks</td></tr>
</table>

13. Method of assessment

Remembering (K1)	• The lowest level of questions requires students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook. • Suggested Keywords: **Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why**
Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combined at altogether • Suggested Keywords: **Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate**
Application (K3)	• Students have to solve problems by using / applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response. • Suggested Keywords: **Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize**
Analyze (K4)	• Analyzing the question is one that asks the students to breakdown something into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. • Suggested Keywords: **Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme**
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem–solving. • Evaluation questions do not have single right answers. • Suggested Keywords: **Agree, Appraise, Assess, Award, Choose, compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value**

Create **(K6)**	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem solving skills • Suggested Keywords: **Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory**

SEMESTER I

FUNCTIONAL MORPHOLOGY AND PHYLOGENY OF INVERTEBRATA

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE – 1**
COURSE NAME: FUNCTIONAL MORPHOLOGY AND PHYLOGENY OF INVERTEBRATA	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To relate the morphological adaptations and functional anatomy with phylogenetic study of Invertebrata and Chordata.

COURSE OUTCOMES:

1. Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of invertebrata.
2. Understand the patterns of feeding, digestion and respiration of invertebrates.
3. Develop a holistic appreciation on the phylogeny and adaptations in invertebrata.
4. Evaluate and to create the perfect phylogenetic relationship, evolutionary significance of larval forms of invertebrata.
5. Acquire in-depth knowledge of phylogeny and evolutionary significance of Cephalochordates and Urochordates ensuring the inculcation of employment skills so that students can make a career in diverse fields of wildlife biology.

Unit I **10 Hrs**

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

Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; **Locomotion**: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata

Unit II **13 Hrs**

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata - Polymorphism in Coelenterates

Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration

Unit III **15 Hrs**

Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules; Mechanisms of excretion; Excretion and osmoregulation.

Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neural evolution

Unit IV **12 Hrs**

Invertebrate larvae (Crustacea and Echinodermata): Larval forms of free-living invertebrates - Larval forms of parasites - Parasitism in Platyhelminthes and nematodes; Strategies and Evolutionary significance of larval forms.

Unit V **10 Hrs**

Minor Phyla: Organization and general characters of Ectoprocta, Entoprocta, Rotifera and Chaetognatha.

Invertebrate fossils: Trilobites and cephalopods. Phylogeny and evolutionary significance of Cephalochordates and Urochordates.

PRESCRIBED BOOKS:

1. Barrington, E.J. W. 1969. Invertebrate Structure and Functions. English Language, Book Society.
2. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
3. Kotpal, 2019. R.L. Modern Text Book of Zoology Invertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

REFERENCE BOOKS

1. Barnes: Invertebrate Zoology – Toppan International Co.,
2. Hyman L. H. The Invertebrata, Vol. I to IV.
3. Carter, G. S. A General Zoology of Invertebrates, (Side wick and Jackson Ltd., (London)
4. Borradile, L. A. The Invertebrata. Cambridge University Press.
5. Gardinar, M. S. 1972 Biology of the Invertebrates, Mc Graw Hill Book Co., New York.
6. R. L. Kotpal: Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
7. Moore, R. C. Lalilcker, C.G. and Fisher, A. G. Invertebrate Fossils, Mc. Graw Hill Book Co., New York.

E-LEARNING RESOURCES

1. https://www.youtube.com/watch?v=q_rt8GzYcgg
2. https://youtu.be/fWVMKLsRE6s
3. https://youtu.be/YCq0HQsu4_4
4. https://youtu.be/kgZRZmEc9j4
5. https://www.youtube.com/watch?v=STHu4dESJH0

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
			TOTAL	**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	1
II	3	2	1
III	2	2	1
IV	2	2	1
V	2	1	2
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**2**	**3**	**3**
CO 2	**3**	**1**	**2**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**2.6**	**2.6**	**3**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of invertebrata.	PSO1, PSO2, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand the patterns of feeding, digestion and respiration of invertebrates.	PSO1, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Develop a holistic appreciation on the phylogeny and adaptations in invertebrata.	PSO1, PSO2, PSO3 PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Evaluate and to create the perfect phylogenetic relationship, evolutionary significance of larval forms of invertebrata.	PSO1, PSO2, PSO3 PSO4, PSO5	K1, K2, K3, K4, K5,K6
CO5	Acquire in-depth knowledge of phylogeny and evolutionary significance of Cephalochordates and Urochordates ensuring the inculcation of employment skills so that students can make a career in diverse fields of wildlife biology.	PSO1, PSO2, PSO3 PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

CELL AND MOLECULAR BIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 2**
COURSE NAME: CELL AND MOLECULAR BIOLOGY	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To impart knowledge of genome and signaling concepts in cell and Molecular Biology.

COURSE OUTCOMES:

1. Explain the structural organization and function of intracellular organelles.
2. Discuss the enzymology of DNA and RNA, replication and types of RNA.
3. Describe the Genetic code, RNA processing, information transfer in prokaryotes and eukaryotes
4. Evaluate the signaling concepts, cell surface receptors and pathways of intracellular signal transduction.
5. Elucidate the cancer cell, tumor suppressor genes, metastasis and molecular treatment of cancer

Unit I **15 Hrs**

Cellular organization: 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 II **12 Hrs**

Informational macromolecules: Chemistry of DNA, Polymorphism of DNA, Mechanism and Enzymology of DNA Replication- Role of Helicases, Primases, Nucleases, Ligases and Telomerases. Chemistry of RNA, Different types of RNA- mRNA, tRNA, rRNA and their functions.

Unit III **10 Hrs**

Information transfer: Genetic code and its characteristic features. Information transfer in prokaryotes and eukaryotes. Transcription – promoters, initiators, terminators. RNA processing – trimming of introns, splicing of exons, Ribozyme.

Unit IV **13 Hrs**

Cell communication and cell signaling: 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 V **10 Hrs**

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

PRESCRIBED BOOKS:

1. Cooper: The Cell, A Molecular approach.

REFERENCE BOOKS:

1. David Frifielder: Molecular Biology.
2. Gerald Karp: Cell Biology- Mc GrawHill.
3. Lodish, Berk, Zipursky, Matsudaria and Baltimore, Molecular cell biology IV edition.
4. W.H. Freeman and Company. George M. Malacinski, 2010. Essential of molecular biology Watson: Molecular Biology of the Gene, 4th edition, Narosa publication.

E – LEARNING RESOURCES:

1. https://static.prepp.in/public/image/Cell_Organization1cab582ab4e5d07f2ff5dd0e24e91fc1.pdf
2. https://www.youtube.com/watch?v=L677-Fl0joY
3. https://www.ncbi.nlm.nih.gov/books/NBK26909/
4. https://www.slideserve.com/nero/cell-signaling-i-signaling-molecules-and-their-receptors
5. https://www.technologynetworks.com/cancer-research/articles/cancer-cells-vs-normal-cells-307366

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
			TOTAL	**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	2	2
II	2	1	1
III	2	2	1
IV	3	2	1
V	2	1	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO1	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**3**	**3**	**3**	**2.8**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the structural organization and function of intracellular organelles	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Discuss the enzymology of DNA and RNA, replication and types of RNA	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Describe the Genetic code, RNA processing, information transfer in prokaryotes and eukaryotes	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Evaluate the signaling concepts, cell surface receptors and pathways of intracellular signal transduction	PSO1, PSO2, PSO3, PSO4	K1, K2, K3, K4, K5, K6
CO5	Elucidate the cancer cell, tumor suppressor genes, metastasis and molecular treatment of cancer	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

GENETICS

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 3**
COURSE NAME: GENETICS	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To understand the fine structure of genetic materials and regulation of their action, chromosomal basis of genetic disorders, development and differentiation.

COURSE OUTCOMES:

1. Understand the basic concept of Genes and explain the mendalism and extension of mendalism.
2. Evaluate the gene expression in prokaryotes and eukaryotes.
3. Discuss the microbial genetics and gene mapping methods. To understand the regulation of gene expression in prokaryotes & eukaryotes and the importance of extrachromosomal inheritance
4. Describe the human genetics with reference to normal and abnormal karyotypes. To understand the application of genetics by pedigree analysis, Genetic Counselling and Human Genome Project. To analyze the molecular mechanism of mutation and the concept of Hardy Weinberg equilibrium.
5. Understand the application of genetics in various field.

Unit I **15 Hrs**

Structure, properties and functions of genetic materials: DNA as the genetic Materials - Structure of chromosome - Packaging DNA molecules into chromosomes - Basic structure of DNA and RNA, alternate and unusual forms of DNA - Physical and Chemical properties of nucleic acid, base properties, denaturation and renaturation, Tm and cot values, hybridization.

Basic Concept of Genes - Allele, Multiple alleles, pseudo allele, complementation tests - One gene one polypeptide concept.

Mendalism and Non Mendalism: Dominance, segregation, independent assortment. Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage (Morgan Experiment) and crossing over, sex linkage, sex limited and sex influenced characters.

Unit II **12 Hrs**

Genetic code: Structure of mRNA- Genetic code –Deciphering the genetic code – Characteristics of genetic code- Translational events – Protein synthesis –Regulation of gene expression in prokaryotes (E. coli) and eukaryotes (Drosophila) – Attenuation and anti-termination – Operon concept – Lac, trp operon. Evidence of regulation of gene action. Hormonal control of gene action.

Unit III **10 Hrs**

Microbial Genetics: Conjugation, transformation and transduction - Gene mapping Method: Linkage maps, tetrad analysis (Neurospora), mapping with molecular markers, mapping by using somatic cell hybrids – Gene Mapping in Bacteria and Drosophila

Unit IV **13 Hrs**

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Human Genetics: Human Karyotyping, Inheritance pattern (autosomal, sex linked, sex limited and sex influenced) – Inborn errors of metabolism in man (With reference to protein, carbohydrates, Lipid and nucleic acid), Structural and numerical alterations of chromosomes (Deletion, duplication, inversion, translocation, ploidy and their genetic implications) - Genetic counselling – Pedigree Analysis - Human genome project: objectives, strategies and progress.

Unit V **10 Hrs**

Quantitative Genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Mutation: Types of Mutation, Mutagens and the mechanism of mutation - Radiation induced mutations.

Applied Genetics – Eugenics, Euthenics & Euphenics. Application of genetics in animal breeding. Application of genetics in Crime and Law - DNA fingerprinting, Genetic basis of intelligence. Studies on Twins.

PRESCRIBED BOOKS:

1. Goodenough U. Genetics. IIIrd Edition, Washington University, Saunders College Publishing.

REFERENCE BOOKS:

1. Swanson, O.P., Timothy Herz and William, J. Young: Cytogenetics -The chromosome indivision, inheritance and evolution, Prentice Hall.
2. Gardner, B.S., & Smustad, D.P. Principles of Genetics, John Wiley &Sons. 6th Ed.
3. Pierce B. A. (2012). Genetics-A Conceptual Approach. IV Edition. W. H. Freeman and Company
4. Russell, P. J. (2009). Genetics- A Molecular Approach. IIIrd Edition. Benjamin Cummings
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetics Analysis. IX Edition. W. H. Freeman and Co.

E-LEARNING RESOURCES:

1. https://static.prepp.in/public/image/Inheritance_Biology_a621b0c9ae9574b42394296808ac1748.pdf
2. https://www.youtube.com/watch?v=b70PhkR0LlQ

3. https://jiwaji.edu/pdf/ecourse/pharmaceutical/structure%20of%20DNA%20and%20RNA%20and%20functions.pdf
4. https://projects.iq.harvard.edu/files/lifesciences1abookv1/files/11__a_primer_on_gene_regulation_revised_9-24-2018.pdf
5. https://www.youtube.com/watch?v=mCOMD291oBM

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
			TOTAL	**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	2	1
II	2	2	1
III	2	1	1
IV	3	1	2
V	2	2	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**2**	**2**	**3**
CO 2	**3**	**3**	**3**	**2**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**3**	**2.8**	**2.6**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the basic concept of Genes and explain the mendalism and extension of mendalism	PSO1, PSO2, PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO2	Evaluate the gene expression in prokaryotes and eukaryotes	PSO1, PSO2, PSO5	K1, K2, K3, K4, K5, K6
CO3	Discuss the microbial genetics and gene mapping methods. To understand the regulation of gene expression in prokaryotes & eukaryotes and the importance of extrachromosomal inheritance	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Describe the human genetics with reference to normal and abnormal karyotypes. To understand the application of genetics by pedigree analysis, Genetic Counselling and Human Genome Project. To analyze the molecular mechanism of mutation and the concept of Hardy Weinberg equilibrium	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Understand the application of genetics in various field	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

FISHERY BIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: ELECTIVE - 1**
COURSE NAME: FISHERY BIOLOGY	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 3	**TOTAL HOURS: 45**
THEORY	

COURSE OBJECTIVE:

To study the in-depth knowledge about fishes and fish farming systems.

COURSE OUTCOMES:

1. Analyze the current status of Indian fisheries and classify fishes based on berg's classification and learn the culturing and harvesting techniques in aquatic animals, develop knowledge on the fish farm and their maintenance.
2. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques, apply the knowledge about different culture methods in aquaculture and gain knowledge on fish breeding techniques and larval culture, know the live feed and artificial feed formulation and its importance in aquacultures
3. Discuss the breeding techniques involved in inland fisheries like freshwater, estuarine and brackishwater, explain the different sampling methods, age determination of fish using scales, otolith.
4. Identify the different fish diseases, diagnosis and their management strategies.
5. Study the culture and capture fisheries of India, understand Ornamental fishes and central aquaculture organizations, develop entrepreneurial skills in aquaculture field.

Unit I **5 Hrs**

Introduction of Fish: Definition – salient features of the fishes - Berg's classification. World and Indian Fisheries – Current concepts of culturable fin fishes, Prospects, Problems, Present status, and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - in India. Types of fish culture -Types of fish ponds for culture practice.

Unit II **10 Hrs**

Fish Seed Production, Food & Feeding Management: Procurement of Brood stocks from natural resources- collection methods and segregation. Hatchery technology for fin fishes. Artificial seed production –Breeding under control conditions, induced breeding technique, larval rearing, packing and transportation. Classification of fish feed- Artificial feeds Types, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.

Unit III **10 Hrs**

Reproduction & Growth Studies: Role of hormones in reproduction and induced breeding-maturity stages – Morphological and Histological observation of gonads. Length-weight relationship – Age Determination and growth – Studies on stomach content and its significance.

Ornamental fish- Development of brood stocks -Selection of brood fishes- Breeding of Egg layer and Live bearers. List of fresh water and marine Ornamental fishes available in India for export with its indicative prices- Role of woman in Ornamental fish culture.

Unit IV **10 Hrs**

Health Assessment: Fish diseases and Fish health management – Infectious Diseases -Bacterial, fungal, viral, protozoan; Non-infectious and nutritional diseases. Disease diagnosis, prevention and control measures. Fish immunization and vaccines.

Unit V **10 Hrs**

Culture and Capture Fisheries in India: Culture fisheries: Marine fisheries of India: Fisheries resources in pelagic and demersal, demand, utilization and their exploitation, Different types of nets and traps; traditional, non-mechanized and mechanized gears. Brackish water fisheries of India: Resources, cultivable species, demand. Fresh water fisheries of India: Riverian fisheries, reservoir fisheries, pond fisheries, tank fisheries, cold water fisheries. Farm culture: Extensive, semi-intensive and intensive culture, integrated farming, cage culture, pen culture, raceway culture, Sewage fed fish culture. Monoculture and Polyculture. Central and state aquaculture research organizations – ICAR - CMFRI, ICAR - CIBA, ICAR - CIFT, ICAR - CIFA, ICAR - CIFRI, ICAR - CIFE, MPEDA, NFDB and TANUVAS and its activities.

PRESCRIBED BOOKS:

1. Jhingran, V.G. 1982. Fish and Fisheries of India. Hindustan Publishing Corporation, pp-751.
2. Rounseefell, 1985. Fishery Science, John Wiley Publisher.
3. Bardach, J.E., Ryther, J.H. and Miller, W.D. 1987. Aquaculture, B. John Wiley & Sons, New York.
4. Barnabe, G. 1991. Aquaculture Vol. 1 & 2. Ellis Horwood, NewYork.
5. Pillay, T.V.R. and M.N. Kutty. 2011. Aquaculture: Principles and Practices, Blackwell Publisher, pp-640.

REFERENCE BOOKS:

1. Gupta, S.M.,2010. Text book of fishery, Ann Backer, Mumbai.
2. Hanifa, M. A, 11. Aquatic resources and aquaculture, Dominent, NewDelhi.
3. Pandey. K and Shukla, J.P.2010. Fish and fisheries, Rastogi Publications, Meerut.
4. Parihar, R. P.1996. A textbook of fish biology and Indian fisheries, central publishing house, Allahabad, India.
5. Khanna, S. S., and Singh H.R. 2012. A text book of fish biology &fisheries, Narendra publishing house.
6. Baluyut, E.A. (1989). Aquaculture systems and Practices. A selected review Publishing House, New Delhi.
7. Chondar. A. (1970). Hand book of breeding of Indian major carps by pituitary hormone injection. Agra Satish Book Enterprise.
8. Day. F (1958). Fishes of India, Vol. I and Vol. II. William Sawson and Sons Ltd., London
9. Jhingran, C. G. (1981). Fish and Fisheries of India. Hindustan Publication Co., India.

E-LEARNING RESOURCES:

1. https://www.fisheriesindia.com/2019/12/fisheries-statistics-of-world-and-india.html
2. https://timesofindia.indiatimes.com/india/central-marine-fisheries-research-institute-releases-annual-marine-fish-landings-data-from-indian-coasts/articleshow/70193648.cms
3. https://en.wikipedia.org/wiki/Fishing_in_India
4. https://www.researchgate.net/figure/Fish-stock-assessment_fig1_267687234/download
5. https://ariesagro.com/rise-of-aqua-culture-in-india/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	2	2	1
III	3	2	1
IV	2	1	1
V	3	1	2
TOTAL	12	8	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**2**	**3**	**3**	**3**	**2**
CO 5	**2**	**3**	**3**	**3**	**3**
Ave.	**2.6**	**3**	**3**	**3**	**2.8**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze the current status of Indian fisheries and classify fishes based on berg's classification and learn the culturing and harvesting techniques in aquatic animals, develop knowledge on the fish farm and their maintenance	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques, apply the knowledge about different culture methods in aquaculture and gain knowledge on fish breeding techniques and larval culture, know the live feed and artificial feed formulation and its importance in aquacultures	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Discuss the breeding techniques involved in inland fisheries like freshwater, estuarine and brackishwater, explain the different sampling methods, age determination of fish using scales, otolith	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Identify the different fish diseases, diagnosis and their management strategies	PSO2, PSO3, PSO4	K1, K2, K3, K4, K5, K6
CO5	Study the culture and capture fisheries of India, understand Ornamental fishes and central aquaculture organizations, develop entrepreneurial skills in aquaculture field	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

PRACTICAL – 1
INVERTEBRATA, GENETICS, CELL AND MOLECULAR BIOLOGY & FISHERY BIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE PRACTICAL - 1**
COURSE NAME: INVERTEBRATA, GENETICS, CELL AND MOLECULAR BIOLOGY & FISHERY BIOLOGY	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**

INVERTEBRATA

Dissection

Earthworm : Digestive and Nervous system
Pila : Digestive and nervous systems
Sepia : Nervous system
Cockroach : Nervous system and Salivary gland
Grasshopper : Digestive system and mouth parts
Prawn : Nervous and Digestive systems
Crab : Nervous and Reproductive system

Mounting

Earthworm : Body setae & Penial setae
Prawn : Appendages
Pila : Radula
Cockroach : Mouth parts
Grasshopper : Mouth parts

Study of the following

1. Identification study and medical importance of selected Protozoans and Helminthes.
2. Identification study and sections of Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of Coelom.
3. Identification study and larval forms from all Major Phyla of Invertebrates.
4. Identification study of Invertebrate Fossils.
5. Commercially important Invertebrates: Crab, Lobsters, Pearl Oyster, Edible Oyster, Mytilus, Sepia and Loligo.

CELL AND MOLECULAR BIOLOGY

I. Cytological techniques

a) Microscopy – Compound and Light Microscope.
b) Study on Camera Lucida.
c) Micrometry: Microscopic calibration and Measurements of cell size using ocular and stage micrometers.
d) Estimation of total RBC count in human blood.

e) Estimation of total WBC count in human blood
f) Blood cells – Differential count in man.
g) Mounting of Human Buccal Smear for squamous epithelial tissue.
h) Study of mitotic cell division by Squash preparation Onion root tip.
i) Study of meiotic cell division by mounting of testis of Grasshopper.
j) Identification of blood cells in the hemolymph of the of the cockroach

II. Histological techniques in animal tissues

a) Fixation,
b) Dehydration,
c) Embedding,
d) Staining and
e) Mounting.

GENETICS

1. Preparation of culture medium and culture of Drosophila-methods of maintenance.
2. Identification of Drosophila species and mutants.
3. Preparation of Human karyotypes – Analysis of Normal and abnormal. Karyotypes (Down's syndrome, Turner's syndrome, Klinefelter's syndrome).
4. Study of Giant Chromosome – Chironomus larva.
5. Problems relating to the application of binominal theorem in population genetics with reference to P.T.C. and Earlobe attachment.

FISHERY BIOLOGY

1. Morphometric and Meristic characteristic features of Fish.
2. Identification of: a) Marine, fresh water and estuarine fishes up to species level.
   b) Cultivable prawns.
3. Age determination in fishes by Scale method and Otolith method.
4. Observation of maturity stages of gonads and determination of Gonado somatic index and fecundity in Fishes.
5. Gut content analysis of fishes in relation to feeding habits.
6. Observation of Gears and Crafts.
7. Observation of fish ectoparasites.
8. Observation of Larvivorous fishes and Aquarium fishes.
9. Observation of seaweed species and their economic importance.
10. Observation of Live feed organisms.

SEMESTER II

FUNCTIONAL MORPHOLOGY AND PHYLOGENY OF CHORDATA

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 4**
COURSE NAME: FUNCTIONAL MORPHOLOGY AND PHYLOGENY OF CHORDATA	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To understand the concept of Prochordates and chordates of genetic materials and regulation of their action, chromosomal basis of genetic disorders, development and differentiation.

COURSE OUTCOMES:

1. Remember the general concepts on origin, classification, functions and distribution of vertebrates.
2. Understand the evolutionary process. All are linked in a sequence of life patterns.
3. Apply this for pre-professional work in agriculture and conservation of life forms.
4. Analyze what lies beyond our present knowledge of life process.
5. Familiarize taxa level identification, understand the complex interactions and diversity of Chordata.

Unit I **12 Hrs**

Origin of vertebrates: Concept of Prochordates; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.

Origin and classification of vertebrates: Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

Unit II **12 Hrs**

General plan of circulation in various groups: Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs

Unit III **12 Hrs**

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

Unit IV **12 Hrs**

Sense organs: Simple receptors; Organs of Olfaction and taste; Lateral line system; Electroreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.

Unit V **12 Hrs**

General Studies in vertebrata: Migration and Parental care in fishes & amphibians. Fossae in Reptiles and its importance in biosystematics. Evolutionary significance of Archaeopteryx.

Migration in Birds - Flight adaptation - Types of beaks in birds. Flightless birds - Adaptive radiation in mammals.

PRESCRIBED BOOK:

1. Newman, The Phylum Chordata, Mac Millan and Co.
2. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

REFERENCE BOOKS

1. Colbert, E.H. Evolution of Vertebrates. Wiley Eastern Limited.
2. Hyman, L.H – Comparative Vertebrate Zoology. University of Chicago Press.
3. Romer, A.S. Vertebrate body. Saunders Company.
4. Young, J.A- Life of Vertebrates. Oxford press.
5. Waterman, A.J – Chordate structure and Function. Mac Millan and co.

E-LEARNING RESOURCES

1. https://www.youtube.com/watch?v=q_rt8GzYcgg
2. https://youtu.be/fWVMKLsRE6s
3. https://youtu.be/YCq0HQsu4_4
4. https://youtu.be/kgZRZmEc9j4
5. https://www.youtube.com/watch?v=STHu4dESJH0

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	2
II	2	2	1
III	2	2	1
IV	2	1	1
V	3	2	1
TOTAL	12	8	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**2**	**2**	**3**	**3**
CO 2	**3**	**2**	**2**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**2.6**	**2.6**	**3**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Remember the general concepts on origin, classification, functions and distribution of vertebrates.	PSO1, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns	PSO1, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Apply this for pre-professional work in agriculture and conservation of life forms	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Analyze what lies beyond our present knowledge of life process	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Evaluate and to create the perfect phylogenetic relationship in classification	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

ANIMAL PHYSIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 5**
COURSE NAME: ANIMAL PHYSIOLOGY	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To enlighten the functional aspects of organ system in the body of animal and man.

COURSE OUTCOME

1. Discuss homeostasis with reference to osmoregulation, temperature and pH in animals and learn the comparative anatomy of heart structure and functions.
2. Describe the physiology of respiration and circulation.
3. Study the mechanism in neurotransmission and muscle coordination.
4. Acquire knowledge on the physiology of digestion and excretion.
5. List out the endocrine glands in Mammals, hormones and its functions.

Unit I **10 Hrs**

Blood and circulation: Blood corpuscles, hemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, hemoglobin, immunity, hemostasis - Ionic and osmoregulation in crustaceans and fishes

Cardiovascular system: Comparative anatomy of heart structure, myogenic heart, specialized tissue, Hamburger's phenomenon, blood pigments and functions; ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above

Unit II **13 Hrs**

Respiratory system: Comparison of respiration in different class, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration

Unit III **15 Hrs**

Nervous system: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture - nerve impulse – Synaptic transmission - Sense organs: Vision, hearing and tactile response

Muscles: Types of muscles - Mechanism of muscle contraction- Regulation and energetics of contraction - Role of Calcium and vitamins in muscle contraction - Energy Sources for Muscle Contraction - Contraction of smooth muscles and Cardiac muscles – fatigue, twitch, summation, tetanus, and Rigormortis

Unit IV **12 Hrs**

Digestive system: Digestion, absorption, energy balance, BMR.

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance

Unit V **10 Hrs**

Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. Thermoregulation: Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization: Stress and adaptation.

PRESCRIBED BOOKS:

1. Hoar, W.S. General and Comparative Physiology.
2. Comparative Animal Physiology C. Ladd Prosser Thomson Learning 1991
3. Animal Physiology Dr. P. S. Verma, B.S. Tyagi &V. K. Agarwal S. Chand Publishing Company.

REFERENCE BOOKS:

1. David Saunders: An Introduction to Biological Rhythms.
2. K. Nagabushanam, M.S.Kodarkar and R.Sarojini: An Introduction to Animal Physiology.
3. Prosser C.L.Comparative animal physiology.
4. Schmidt-Nielson: Animal physiology.
5. Animal Physiology and Biochemistry Dr.Kaushal Kumar & Dr.Anil.D.Srivastava S.Chand Publishing company pvt., Ltd 2016
6. Mammalian endocrinology Ashoke Kumar Boral New Central Book Agency (P) Ltd 2016.

E-LEARNING RESOURCES:

1. https://courses.lumenlearning.com>digestive system/Anatomy and Physiology
2. https://www.ck12.org>system
3. https://www.opentextbc.chapter>Basic
4. https://www.dmu.edu>medterms
5. https://www.lung.ca>lung
6. https://archive.org/details/endocrinology00hadl/page/n5/mode/1up
7. https://www.toppr.com/guides/biology/chemical-coordination-and integration/mechanism-ofhormone-action/
8. https://www.tocris.com/research-area/neuropeptides
9. http://www.pathophys.org/sexhormones/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	2	1
II	2	1	1
III	2	2	2
IV	3	1	1
V	2	2	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**2**
CO 2	**3**	**2**	**3**	**3**	**3**
CO 3	**3**	**2**	**3**	**3**	**2**
CO 4	**3**	**2**	**3**	**3**	**2**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**2.4**	**3**	**3**	**2.4**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Discuss homeostasis with reference to osmoregulation, temperature and pH in animals and learn the comparative anatomy of heart structure and functions.	PSO1, PSO2, PSO3, PSO4	K1, K2, K3, K4, K5, K6
CO2	Describe the physiology of respiration and circulation.	PSO1, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Study the mechanism in neurotransmission and muscle coordination.	PSO1, PSO3, PSO4	K1, K2, K3, K4, K5, K6
CO4	Acquire knowledge on the physiology of digestion and excretion.	PSO1, PSO3, PSO4	K1, K2, K3, K4, K5, K6
CO5	List out the endocrine glands in Mammals, hormones and its functions.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

IMMUNOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 6**
COURSE NAME: IMMUNOLOGY	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.

COURSE OUTCOME:

1. Understand the various basic concepts in immunology and organization of immune systems.
2. Acquire the knowledge on antigenicity and immunogenicity.
3. Learn about the major effector components of cellular immune system.
4. Describe the structural and functional characteristics of various antibody classes and monoclonal antibodies.
5. Remember the mechanisms of immune response in health and their defects in various diseases; Vaccinology and its importance in disease management.

Unit I **15 Hrs**

Introduction to Immunology: An overview; Scope of immunology, recognition of self and non-self as a basic functional feature of immune system; Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system: cellular and humoral immune components-distribution, salient functions-primary and secondary immune responses; Immune tissues / organs: types, anatomical location, structure and development; lymphocyte traffic during development; Types of immunity: innate and acquired - types, functional features; concept of adaptive immunity

Unit II **10 Hrs**

Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications

Unit III **10 Hrs**

Major effector components of cellular immune system: Lymphocytes - types, morphology, clones; sub-populations, distribution, B and T cell receptors, B and T cell epitopes, Toll-like receptors; Antigen presenting cells: antigen processing and presentation, MHC molecules and their immunologic significance

Unit IV **15 Hrs**

Major effector components of humoral immune system: Antibodies - Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications. Complement system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation. Cytokines - Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons - Origin, types and functions

Unit V **10 Hrs**

Diseases and immune responses: Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases: onset, spectrum of diseases, and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens; Vaccines: types, preparations, efficacies and recent developments.

PRESCRIBED BOOKS:

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

REFERENCE BOOKS:

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. *et al*., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
9. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7^{th} Edition), Macmillan, England, pp-692.

E-LEARNING RESOURCES:

1. https://www.ncbi.nlm.nih.gov/books/NBK26921/
2. https://youtu.be/UsZ_zHfFeR0?si=JeT92No7vfXslA9d
3. https://www.google.co.in/url?sa=t&source=web&rct=j&opi=89978449
4. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Map%3A_Raven_Biology_12th_Edition/50%3A_The_Immune_System/50.03%3A_Cell-Mediated_Immunity
5. https://www.ncbi.nlm.nih.gov/books/NBK22243/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	2
II	2	2	1
III	2	1	1
IV	2	2	1
V	3	2	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**2**	**3**
CO 2	**3**	**3**	**3**	**2**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**2**
Ave.	**3**	**3**	**3**	**2.6**	**2.8**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the various basic concepts in immunology and organization of immune systems.	PSO1, PSO2, PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO2	Acquire the knowledge on antigenicity and immunogenicity.	PSO1, PSO2, PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO3	Learn about the major effector components of cellular immune system.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Describe the structural and functional characteristics of various antibody classes and monoclonal antibodies.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Remember the mechanisms of immune response in health and their defects in various diseases; Vaccinology and its importance in disease management.	PSO1, PSO2, PSO3, PSO4	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: ELECTIVE - 2**
COURSE NAME: ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 3	**TOTAL HOURS: 45**
THEORY	

COURSE OBJECTIVE:

To study about the insects, their habitats and physiology; to acquire the knowledge on the economic importance of insects.

COURSE OUTCOMES:

1. To study the biology of an insect with reference to nutrition, development, reproduction and Endocrinology.
2. Know the life cycle, rearing and management of diseases of beneficial insects.
3. Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control and to discuss the injuries and loss caused by pest and the impact of insect in human and domestic animals.
4. Recognize insects which act as vectors causing diseases in animals and human and to list out the different control methods of pest and their mode of action.
5. To describe the insecticide formulations in pest control and its impact on environment.

UNIT I **10 Hrs**

Brief account of morphology, classification (Major orders) and development (Metamorphosis) of insects. Biology of an insect with special reference to the following: Nutrition, Development, Reproduction and Endocrinology. Insects and their interrelationships with environments (Interspecific and Intraspecific).

UNIT II **5 Hrs**

Beneficial insects: 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 **15 Hrs**

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 Rice - Rice leaf folder, Rice stem borer, Rice thrips, Rice gall midge, Rice mealy bug, Green rice

leaf hoppers, Brown plant hopper, Rice ear head bug, Rice grass hoppers, Whorl maggot, Pests of sugarcane - Sugarcane Shoot borer, Stem or internode borer, Top borer, Termites, White grubs, Sugarcane leaf hopper, Sugarcane scale, Mealy bug, White flies, Pests of vegetables - Shoot and fruit borer, Stem borer, Spotted leaf beetle, Grey weevil, Tomato – Fruit borers, Serpentine leaf miner, – Pests of lady's finger and gourds., Pests of coconut - Rhinoceros beetle, Red palm weevil, Black-headed caterpillar, White grub and Pests of stored grains cereals - Rice weevil, Sweet potato weevil, Lesser grain borer, Tobacco beetle, Drug store beetle, Pulse beetle, Tamarind beetle, Red flour beetle, Indian meal moth, Fig moth, Rice moth, Khapra beetle.

UNIT IV **10 Hrs**

Methods of pest control – Natural control – Applied or artificial control – Prophylactic methods – Curative or direct methods – Cultural methods – Mechanical methods – Physical methods – Biological methods – Chemical methods – Insect attractants – Repellents – Antifeedant – Genetically modified crops – Bt cotton – Bt brinjal – Bt maize.

UNIT V **5 Hrs**

Pesticide – Basic principles of insecticide formulations and their application in pest control. Classification of Insecticides- Inorganic, organic and synthetic organic compounds. Plant protection appliances- Dusters and Sprayers, Aircraft and Other equipment's. Pesticides and environmental pollution – Precautions in handling pesticides. Integrated Pest Management.

PRESCRIBED BOOKS:

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

REFERENCE BOOKS:

1. M.S. Nalinasundari and R. Santhi. 2008. Entomology, MJP Publishers, Chennai.
2. Ambrose, Dunston P. 2004. The Insects; Structure, function and Biodiversity. Kalyani publishers, Ludhiana, New Delhi, Chennai.
3. Nayar, K.K., Ananthakrishnan, T.N. and David, B.V. 1986. General and applied entomology, Tata McGraw Hill Publications, New Delhi.
4. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot. Chennai – 15.
5. Chapman, R.F., S.J. Simpsonand A.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
6. Snodgrass, R.E. 1985. Principles of Insect Morphology, McGraw Hill and Co., New York
7. Mary Louise Flint and Robert Van den Bosch. 1983. Introduction to Integrated Pest Management. Plenum Press, New York.
8. Chapman.R.F.1998.The insect's structure and function .4th edition, Cambridge University Press, UK.

E-LEARNING RESOURCES:

1. http://eagri.org/eagri50/ENTO232/index.html
2. http://eagri.org/eagri50/ENTO331/index.html
3. https://agritech.tnau.ac.in/pdf/6.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	3	2	1
III	2	1	2
IV	3	1	1
V	2	2	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**3**	**2**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**2**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**2.6**	**3**	**3**	**3**	**2.8**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	To study the biology of an insect with reference to nutrition, development, reproduction and Endocrinology	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Know the life cycle, rearing and management of diseases of beneficial insects	PSO1, PSO2, PSO3, PSO4	K1, K2, K3, K4, K5, K6
CO3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control and to discuss the injuries and loss caused by pest and the impact of insect in human and domestic animals	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Recognize insects which act as vectors causing diseases in animals and human and to list out the different control methods of pest and their mode of action	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	To describe the insecticide formulations in pest control and its impact on environment	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

PRACTICAL – 2

CHORDATA, ANIMAL PHYSIOLOGY, IMMUNOLOGY AND ENTOMOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE PRACTICAL - 2**
COURSE NAME: CHORDATA, ANIMAL PHYSIOLOGY, IMMUNOLOGY AND ENTOMOLOGY	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 150**

CHORDATA

Dissection

1. Identification of important Prochordates, Fishes, Amphibians, Reptiles, Birds and Mammals.
2. Digestive system of Teleost Fish.
3. Dissection and Display of Arterial and Venous System, in Teleost fish.
4. Mounting of brain of fish.

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

ANIMAL PHYSIOLOGY

1. Estimation of Respiratory Quotient in fish with reference to Temperature.
2. Oxygen consumption in a terrestrial animal (cockroach).
3. Ciliary activity of Fresh Water Mussel in relation to Temperature.
4. Salt loss and salt gain in fish.
5. Estimation of excretory products in Chordates.
6. Determination of amino acids in the tissues (Liver/muscle) of fish/egg albumin (paper chromatography).

7. Principles and applications of the following instruments:
    a) Kymograph,
    b) Spectrophotometer,
    c) Sphygmomanometer,
    d) Electrophoretic Unit.

IMMUNOLOGY

1. Identification of various immune tissues and organs in rat
2. Identification of various types of immune cells in peripheral blood smear
3. Separation of RBC as intact cellular antigen for immunization
4. Antigenic challenge of mammalian hosts through different routes, and comparative evaluation of their merits and demerits
5. Methods of blood sampling
6. Preparation and storage of antiserum
7. Agglutination reaction: Qualitative analysis of antigen-antibody reaction using human blood group system
8. Agglutination reactions: Determination of hemagglutination titre of IgM antibodies using human RBC
9. Separation of lymphocytes from peripheral blood and identification of T and B cells

ENTOMOLOGY

1. Study of morphology of an insect (local insects to be used).
2. Dissection of digestive, nervous, excretory, reproductive systems of any two insects of different orders.
3. Taxonomy: Field study to collect insect species - Identification and Displaying of at least 10 insects belonging to different orders.
4. Identification of different types of Mouth parts in insects.
5. Distinguishing characters of mosquitoes by using key characters.
6. Life cycle of Insects.
7. Study of Termitarium.
8. Medical Entomology: Medical importance of Rat Flea and House fly.
9. Control: Insecticide formulations and mixtures, common natural enemies of crop pests; Light Trap, Poison Bait.
10. Storage Entomology: Field study for various methods of pest management - Collection, identification and familiarization with the stored grains/seed insect pests and nature of damage caused by them.
11. Plant protection appliances: Field visit to wear houses and Plant protection centers to study Dusters and sprayers.

SEMESTER III

DEVELOPMENTAL BIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 7**
COURSE NAME: DEVELOPMENTAL BIOLOGY	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

Developmental biology helps to understand the ontogeny of animals. To study the interaction between living organism and the environment.

COURSE OUTCOMES:

1. Describe the basic concepts of development, Gametogenesis and Fertilization.
2. Explain the early embryonic development, Morphogenesis and organogenesis.
3. Differentiate the blastula and gastrula stages.
4. Learn the distinguishing features of three different germ layers and formation of various tissues and organs.
5. Discuss the chemical nature of inducing substances in embryonic induction, regeneration in animals and gene regulation of ageing.

Unit I **15 Hrs**

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

Gametogenesis: Oogenesis - Types of eggs – Growth, development and maturation of oocyte – Nuclear activities during oocyte growth – Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Spermatogenesis - Seminiferous tubules - Differentiation of spermatozoa. Genetic control of vitellogenin synthesis in amphibians

Unit II **10 Hrs**

Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitation 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 **10 Hrs**

Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition - Primary organ rudiments - Metabolism and gene activity during gastrulation - 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 **10 Hrs**

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 **15 Hrs**

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 associated with regeneration. Aging and senescence's: Biology of senescence's- 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.

PRESCRIBED BOOKS:

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.

REFERENCE BOOKS:

1. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.

2. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
3. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.
4. Verma P.S and Agarwal V.K, (2010). Chordate Embryology, S Chand; Reprint of 1975 first edition
5. M.J. Berrill–Developmental Biology. (1986) Tata Mc Graw Hill, publications Ltd.
6. Raven: An outline of developmental physiology. Porgaman press.
7. Robert S.Rugh: The frog Reproduction. (1951) Tata Mc Graw Hill publications Ltd.
8. Gibbs. (2006). Practical Guide to Developmental Biology. Oxford University Pres
9. Werner. A. Muller. (2008). Developmental Biology. Springer.

E-LEARNING 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.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	1
II	2	1	1
III	2	2	1
IV	2	2	1
V	3	2	2
TOTAL	12	8	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**2**	**2**	**3**
CO 2	**3**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**2**	**1**	**2**
CO 4	**3**	**3**	**2**	**1**	**3**
CO 5	**3**	**3**	**2**	**3**	**3**
Ave.	**3**	**2.8**	**2**	**1.8**	**2.8**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe the basic concepts of development, Gametogenesis and Fertilization.	PSO1, PSO2, PSO5	K1, K2, K3, K4, K5, K6
CO2	Explain the early embryonic development, Morphogenesis and organogenesis.	PSO1, PSO2, PSO5	K1, K2, K3, K4, K5, K6
CO3	Differentiate the blastula and gastrula stages.	PSO1	K1, K2, K3, K4, K5, K6
CO4	Learn the distinguishing features of three different germ layers and formation of various tissues and organs.	PSO1, PSO2, PSO5	K1, K2, K3, K4, K5, K6
CO5	Discuss the chemical nature of inducing substances in embryonic induction, regeneration in animals and gene regulation of ageing.	PSO1, PSO2, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

ENVIRONMENTAL BIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 8**
COURSE NAME: ENVIRONMENTAL BIOLOGY	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

Knowing the ecology and climatic changes at world level and its impact on natural resources.

COURSE OUTCOMES:

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

Unit I **10 Hrs**

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Habitat Ecology- lake, marine, rocky, muddy and sandy shore, estuary, terrestrial grassland, forest, desert.

Unit II **10 Hrs**

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.

Unit III **15 Hrs**

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and

attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax

Unit IV **10 Hrs**

Ecosystem: Structure and function; energy flow and mineral cycling (CNPS); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation of natural resources and biota-soil conservation.

Unit V **15 Hrs**

Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Bioremediation: Definition; Need and scope; Environmental application; Future outlook; Phytoremediation: – biotechnology of cleaning up the environment by plants.

PRESCRIBED BOOKS

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.

REFERENCE BOOKS

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.
4. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
5. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.

E-LEARNING RESOURCES:

1.Online courses.nptel.ac.in / noc 19 - g e 23/preview
2. Class central.com/course/swayam -ecology - and environment – 14021

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	3	1	1
III	2	2	1
IV	2	2	1
V	3	1	2
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**3**
CO 2	**3**	**3**	**2**	**3**	**3**
CO 3	**3**	**3**	**3**	**2**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**2**	**3**	**3**
Ave.	**3**	**3**	**2.6**	**2.8**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn about the ecosystem, biotic communities and utilizing the energy processing	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Study the various community and population and population control	PSO1, PSO2, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Understand the fundamentals of climatic conditions and its impact on environment	PSO1, PSO2, PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO4	Realizing the nature of pollution and the ways for its control/reduction	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Impact of environmental studies on solid waste management	PSO1, PSO2, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

EVOLUTION AND ANIMAL BEHAVIOUR

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 9**
COURSE NAME: EVOLUTION AND ANIMAL BEHAVIOUR	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

Understand the factors responsible for origin and generation of diversity among living beings and understand basic concepts in Animal behaviour.

COURSE OUTCOMES:

1. Understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.
2. Describe the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.
3. Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.
4. Analyze and identify innate, learned and cognitive behaviour and differentiate between various mating systems.
5. Classify movement and migration behaviors and explain environmental influence upon animal behaviour.

Unit I **15 Hrs**

Emergence of evolutionary thoughts: Emergence of evolutionary thoughts of Lamarck and Neo Lamarckism; Darwin – concepts of variation, adaptation, struggle, fitness and natural selection and Neo Darwinism - Mendalism - Spontaneity of mutations - The evolutionary synthesis.

Origin of cells and unicellular evolution: Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit II **10 Hrs**

Paleontology and evolutionary history: The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including Homo sapiens

Molecular evolution: Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis - Origin of new genes and proteins - Gene duplication and divergence

Unit III **15 Hrs**

The mechanisms: Population genetics - Populations, Gene pool, Gene frequency - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift- Adaptive radiation - Isolating mechanisms – Speciation - Allopatricity and Sympatricity - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution - Adaptive trends – Quantifying adaptation – Colouration and Mimicry. Adaptive radiation in Mammals and reptiles – Genetic Polymorphism: Transient and stable - Maintenance of polymorphism.

Origin of Higher Evolution: Phylogenetic Gradualism and Punctured equilibrium - Major Trends in the Origin of Higher Categories - Micro, Macro and Mega Evolution - Evolution of Man

Unit IV **10 Hrs**

Animal Behaviour: Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.

Instinct and learning: Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.

Unit V **10 Hrs**

Organization of circadian system in multicellular animals: Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

PRESCRIBED BOOKS:

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
5. Harjindra Singh, 1990. A TextBook of Animal Behaviour, Anomol Publication, 293pp.
6. Hoshang S. Gundevia and Hare Goving Singh, 1996. Animal Behaviour, S.Chand &Co, 280pp

REFERENCE BOOKS:

1. Dobzhansky, T., Genetics and the origin of species. Columbia, Univ. Press, New York.
2. Mayr, E., Systematics and the origin of species, Columbia Univ. Press, New York.
3. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
4. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
5. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring Harbour Laboratory Press.
6. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
7. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
8. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
9. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company, London, 118pp.
10. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

E-LEARNING RESOURCES:

1. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
2. http://www.evolution-textbook.org/
3. https://onlinelibrary.wiley.com/journal/15585646
4. http://darwin-online.org.uk/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	1
II	2	2	1
III	3	1	2
IV	2	2	1
V	2	2	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**2**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**2**	**3**	**3**	**3**
Ave.	**3**	**2.6**	**3**	**3**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution	PSO1, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Describe the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Analyze and identify innate, learned and cognitive behaviour and differentiate between various mating systems	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Classify movement and migration behaviors and explain environmental influence upon animal behaviour	PSO1, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

APPLIED ZOOLOGY AND MICROBIOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: ELECTIVE - 3**
COURSE NAME: APPLIED ZOOLOGY AND MICROBIOLOGY	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 3	**TOTAL HOURS: 45**
THEORY	

COURSE OBJECTIVE:

To know the basic concepts in vermiculture, poultry farming, animal husbandry

COURSE OUTCOMES:

1. Understand various roles of microorganisms, and acquire knowledge in vermiculture, poultry farming and dairy farming.
2. Understand and apply existing scientific knowledge to develop more practical applications.
3. Apply the techniques and practices needed for livestock management.
4. Remember the history, scope and significance of microbes in medical microbiology.
5. Describe the role of beneficial microorganisms in production of Penicillin, Ethanol, Vinegar; microorganisms in food spoilage.

UNIT I **6 Hrs**

Vermiculture techniques, advantages of vermiculture, vermicomposting technology, methods of vermicomposting, large scale manufacture of vermicompost, worm casts, vermicompost, vermiwash, vermiwash production techniques, role of earthworms in soil fertility, use of vermicompost for crop production, use of vermicompost in land improvement and reclamation, potentiality of vermibiotechnology in India.

UNIT II **7 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. Management of chicks, growers and layers. Management of Broilers. Poultry diseases – viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.

UNIT III **7 Hrs**

Introduction to Animal Husbandry- Distinguishing characteristics of Indian and exotic breeds of dairy animals and their performance. Traditional Systems of cattle keeping. General dairy farm practices- identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates.

UNIT IV **10 Hrs**

History and Scope: Milestones in Microbiology- Microbial Taxonomy- Classification system - Morphology - Ultra structure of Bacteria, Fungi and Viruses - Bacterial physiology - Growth and Nutrition - Nutritional requirements - Kinetics of growth. Enumeration of bacteria – Viable plate count - MPN procedure.

Medical microbiology- Pathogenic Microbes in Bacterial- Tuberculosis, Whooping cough and Tetanus. Viral- Measles, Hepatitis and HIV. Protozoan- Amoebiasis and Malaria. Cure, Control and Prevention.

UNIT V **15 Hrs**

Environmental Microbiology- Role of microorganisms in Carbon and Sulphur cycle. Population interaction – Commensalism, Co-metabolism, Mutualism, Competition, Predation and Parasitism

Food and Dairy Microbiology- Microbes in food, Role of microorganisms in food production, Dairy and Non-Dairy-Fermented food and Alcoholic beverages. Microorganisms and Food spoilage**.**

Industrial Microbiology- Industrial uses of microbes- Fermentation products. Production of Penicillin, Ethanol, Vinegar, Methods of Immobilization: Types of Reactors: Animal Cell Bioreactors.

PRESCRIBED BOOKS:

1. Jawaid Ahsan and Subhas Prasad Sinha, 2000 A Handbook on Economic Zoology-ISBN-81-219-0876-O. S. Chand & Co., Ltd., New Delhi.
2. Banerjee, G.C. 1992, Poultry – III- Edition – ISBN-81-204-008-4. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Kaushish, S.K., 2001, Trends in Livestock Research – ISBN-81-7754-112-9. Agrobios (India), Jodhpur – India.
4. Michael. J. Pelczar Jr, Chan. E.C.S, Kriej, Noel. R. Microbiology. Tata Mac Graw hill.
5. T.A. Brown – Gene cloning an Introduction (1995), Third edition Stanley Thornes Publishers.

REFERENCE BOOKS:

1. Ranganathan L.S, Vermicomposting technology- soil health to human health.
2. Keith Wilson, N.D.P., 2005. A Handbook of Poultry Practice – ISBN-81-7754-O-69-6 Agrobios (India), Jodhpur – India.
3. The Veterinary Books for Dairy Farmers by Roger W. Blowey.
4. Hand Book of Dairy Farming by Board Eiri.
5. Handbook of animal husbandry TATA, S.N ed., ICAR 1990
6. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
7. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea & Fibiger Publisher.
8. Dubey, R.C. and Maheshwari, D.K, A text book of Microbiology.

9. Lansing, M. Prescott, John P. Harley and Donald A. Klein. Microbiology Mc Graw Hill (1999)
10. Patel, A.H. - Industrial Microbiology (2001). MacMillan India Limited.
11. Powar and Daginwala: General Microbiology - Vol II Microbiology-fourth edition.
12. Ronald, M. Atlas, Principles of Microbiology (1997)
13. Sharma. P.D, Microbiology- A text book for university students.

E-LEARNING RESOURCES:

1. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html
2. https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	1
II	2	2	1
III	2	2	1
IV	3	2	1
V	2	1	2
TOTAL	12	8	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**3**	**3**	**3**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand various roles of microorganisms, and acquire knowledge in vermiculture, poultry farming and dairy farming.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand and apply existing scientific knowledge to develop more practical applications.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Apply the techniques and practices needed for livestock management.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Remember the history, scope and significance of microbes in medical microbiology.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Describe the role of beneficial microorganisms in production of Penicillin, Ethanol, Vinegar; microorganisms in food spoilage.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

PRACTICAL – 3

DEVELOPMENTAL BIOLOGY, ENVIRONMENTAL BIOLOGY, MICROBIOLOGY AND EVOLUTION

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE PRACTICAL - 3**
COURSE NAME: DEVELOPMENTAL BIOLOGY, ENVIRONMENTAL BIOLOGY, MICROBIOLOGY AND EVOLUTION	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**

DEVELOPMENTAL BIOLOGY

Gametogenesis - Observation of gametes from gonadal tissue sections

a) Oogenesis: Section through ovary of shrimp, fish, frog and mammals
b) Spermatogenesis: Section through testis of shrimp, fish, Calotes and mammals

Fertilization

a) Induced spawning in polycheate worm *Hydroids elegans*
b) *In vitro* fertilization and development in a polycheate worm *Hydroids elegans*
c) Observation of egg developmental stages in *Emerita emeritus*

Embryogenesis

a) Observation and whole mount preparation of the chick blastoderm - 18 hours of development
b) Chick embryonic stage - 24 hours of development
c) Chick embryonic stage - 48 hours of development
d) Chick embryonic stage - 72 hours of development
e) Chick embryonic stage - 96 hours of development

Histological observation: Section through various developmental stages in chick embryo

Experimental Embryology

Regeneration in Frog Tadpoles

a) Blastema formation
b) Demonstration of regenerative process in tadpole Metamorphosis
c) Development stages of Fish
d) Slide showing C.S of Heart, Kidney, Eye lens and Limb of Frog.
e) Development of Invertebrates. Eggs, Cleavage, Gastrula, study of larval forms

ENVIRONMENTAL BIOLOGY

1. Identification of freshwater and marine planktons.
2. Study of rocky, sandy and muddy shore fauna and their adaptations.
3. Determination of the following water quality parameters:
    a) pH
    b) Salinity
    c) Free-Carbon dioxide
    d) Dissolved Oxygen
    e) Chemical Oxygen Demand

f) Calcium
g) Carbonate
h) Bi-carbonate
i) Ammonia
j) Nitrate

4. Analysis of macro and microorganisms in soil and soil litter.
5. Animal associations- parasitism, mutualism and commensalism
6. Estimation of Earthworm population.
7. Analysis of industrial effluent for TDS, TSS and BOD (Demonstration).
8. Study of fauna in their natural habitats by visiting places of Zoological Parks and Biosphere Reserves.

MICROBIOLOGY

I. Sterilization of Glass wares and media

II. Culture medium and preparation

a) Peptone water
b) Nutrient broth
c) Solid media
d) Serial Dilution

III. Staining Techniques

a) Simple Staining
b) Grams Staining

IV. Biochemical Tests

a) Motility
b) Catalase
c) Oxidase
d) Indole
e) Methyl Red
f) Voges Proskauer
g) Triple Sugar Ion
h) Citrate
i) Urease

V. Enumeration of bacterial colonies

a) Direct Plate count
b) Observation of colony morphology (Colour, margin and diameter)
c) Enumerate bacterial colonies and entry on record

VI. Microscopic observation for identification and characterization of following microorganisms.

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

EVOLUTION

1. Observation of forelimbs and hindlimbs of vertebrates – **Frog** to study the common pattern of pentadactyl limb and common ancestry of vertebrates
2. Observation of forelimbs and hindlimbs of vertebrates – **Calotes** to study the common pattern of pentadactyl limb and common ancestry of vertebrates
3. Observation of forelimbs and hindlimbs of vertebrates – **Bird** to study the common pattern of pentadactyl limb and common ancestry of vertebrates
4. Observation of forelimbs and hindlimbs of vertebrates – **Mammal** to study the common pattern of pentadactyl limb and common ancestry of vertebrates
5. Observation of fossils to study paleontological evidences of evolution.
6. Observation of leaf insects and stick insects in the museum to study adaptation by cryptic colouration and natural selection.
7. Observation of Monarch and Viceroy butterflies to study Batesian mimicry.

SEMESTER IV

RESEARCH METHODOLOGY AND BIOSTATISTICS

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE 10**
COURSE NAME: RESEARCH METHODOLOGY AND BIOSTATISTICS	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To understand the basic principle, methodology, processing and analysis of data and applications of widely used software's in biological sciences, to know basic concepts in biostatistics.

COURSE OUTCOMES:

1. Acquire the knowledge on the fundamentals of research and characteristics of scientific methods such as data collection; processing and analysis of data; sampling fundamentals; testing of hypothesis.
2. Understand the components of research report, journals, impact factor, plagiarism and ethical issues in research.
3. Describe the funding resources and designing of research proposals and remember the different software's for paper formatting, reference management and for detection of Plagiarism, biopiracy.
4. Discuss the statistical data and different diagrammatic and graphical forms and analyze the statistical data for the measures of dispersion and for the measures of central tendencies.
5. Apply the elements of probability, sample space, sample point, sample event in life sciences.

Unit-I: 10 Hrs

Introduction to Research Methodology & Research Design: - An Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Importance of knowing how research is done, Research Process, Criteria of good research. Defining the Research Problem; Research Design; Sampling Design; Methods of Data Collection; Processing and Analysis of Data; Sampling Fundamentals; Testing of Hypothesis.

Unit-II: 10 Hrs

Literature Survey: Source of literature – INSDOC, MEDLINE, Biological abstracts, Current Contents, PubMed and Online Journals – Types of literature: reviews, abstracts, short notes, journal articles, magazines, periodicals, books and proceedings – Reprint requisition cards and reprint requesting – Organization of collected information – index cards and style of indexing.

Internet Resources: What is Internet, World Wide Web, Navigating the Internet, Electronic mail, and Electronic publication, Online Journals – Structure and ethics of Scientific presentations.

Unit-III **10 Hrs**

Data Collection: Methods of data collection- Questionnaires/schedule, Selection of appropriate method for data collection – Guidelines for constructing questionnaires – Guidelines for interviewing – Sample questionnaires – Data Analysis and interpretation – Dissertation /Reporting – Steps in report writing – How to critique an article.

Publication: How to write the research Paper and thesis– Indexing – Impact Factor – H- Index – Research Ethics – Ethical issues related to Publishing, Plagiarism and Self – Plagiarism.

Funding Resources and Designing Research Proposals: World Health organization (WHO), Department of Science and Technology (DST), Indian Council for Medical Research (ICMR) – Structure of Research Proposals: Origin, Objectives, Existing Knowledge of the problem, Current status of the problem, Methodology, Budget and expected outcome.

Unit-IV: Biostatistics **15 Hrs**

Sampling and sample Designs- Definitions – Theoretical Basis-Laws – Methods. Sampling and Non-sampling errors, Collection and classification of data – Representation of data –Tabulation of data –Diagrammatic representation of data – differences between diagrams and graphs. Graphic representation of data–frequency distribution.

Measures of Central tendency: Arithmetic Mean, Median and Mode. Definition and computation for different types of data (ungrouped, discrete and continuous frequency distribution). Measures of Dispersion: Range, Mean deviation, Standard deviation and Standard error- ungrouped data, discrete and continuous frequency distribution.

Unit-V: **15 Hrs**

Elements of probability – sample space, sample point, sample event and Venn diagram. Theoretical distributions – fundamentals of Binomial, Poisson and Normal distribution – Central Limit Theorem. Student's t-distribution – characteristics. Use of t-test for small samples. Chi-square test.

Correlation: Characteristics, Types, Methods of study of correlation – scatter diagram method, graphic method, Karl Pearson's coefficient of correlation – rank correlation – concurrent deviation method – significance. Regression – characteristics, dependent and independent variables – slope and intercept – method of least squares - ANOVA.

PRESCRIBED BOOKS:

1. Gurumani: A text Book of Research Methodology.

REFERENCE BOOKS:

1. Doing Your Masters Dissertation, Chris H, 1st edition, Vistaar publications, 2005
2. Research Methodology, Paliniswamy and Shanmugavel.
3. Research Methodology Methods & Techniques, C. R. Kothari.
4. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition

5. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
6. Research Methodology – C.R. Kothari

E-LEARNING RESOURCES:

1. https://dhsgsu.edu.in/images/Reading-Material/Commerce/Econtent/RM-SELF-LEARNING.pdf
2. https://www.researchgate.net/publication/322754828_LITERATURE_REVIEW_SOURCES_AND_METHODOLOGIES
3. https://ncert.nic.in/textbook/pdf/kest104.pdf
4. https://nios.ac.in/media/documents/SecMathcour/Eng/Chapter-25.pdf
5. https://www.cimt.org.uk/projects/mepres/alevel/stats_ch12.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A		SECTION - B		SECTION - C	
	Theory	**Problem**	**Theory**	**Problem**	**Theory**	**Problem**
I	3	-	1	-	1	-
II	2	-	1	-	1	-
III	3	-	2	-	1	-
IV	1	1	1	1	1	1
V	1	1	1	1	-	1
TOTAL	**10**	**2**	**6**	**2**	**4**	**2**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**2**	**3**	**3**	**3**	**3**
CO 2	**2**	**3**	**3**	**3**	**3**
CO 3	**2**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**2.4**	**3**	**3**	**3**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Acquire the knowledge on the fundamentals of research and characteristics of scientific methods such as data collection; processing and analysis of data; sampling fundamentals; testing of hypothesis.	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand the components of research report, journals, impact factor, plagiarism and ethical issues in research.	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Describe the funding resources and designing of research proposals and remember the different software's for paper formatting, reference management and for detection of Plagiarism, biopiracy.	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Discuss the statistical data and different diagrammatic and graphical forms and analyze the statistical data for the measures of dispersion and for the measures of central tendencies.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Apply the elements of probability, sample space, sample point, sample event in life sciences.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

BIOCHEMISTRY AND MEDICAL LABORATORY TECHNOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE - 11**
COURSE NAME: BIOCHEMISTRY AND MEDICAL LABORATORY TECHNOLOGY	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To apply the principles for a better understanding of biological phenomena and to impart knowledge and to understand the different protocols and procedures to collect clinical samples.

COURSE OUTCOMES:

1. Explain the action of enzymes and enzyme kinetics
2. Discuss them metabolic pathways in carbohydrate catabolism, protein metabolism and lipid metabolism.
3. Remember the basic principles of bioenergetics and their pathways.
4. Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.
5. Understand the protocols, procedures of Chromatography and Separation techniques.

UNIT I **10 Hrs**

Nature of living matter- Biomolecules, pH, Buffers. Enzymes – Classification, Nomenclature, Mechanism of enzyme action, coenzymes, classification and functions of Isoenzymes, Apoenzymes, Holoenzymes –Enzyme kinetics.

UNIT II **15 Hrs**

Carbohydrate catabolism – Glycogenolysis and Pentose phosphate pathway –Energy yield in Glycolysis and aerobic respiration – Anaerobic respiration – Lactic acid fermentation – Alcohol fermentation. Protein metabolism- Amino acid metabolism- Oxidative Deamination, Transamination, Decarboxylation, Demethylation Reaction. Lipids- Lipid Metabolism-Metabolism of fatty acids and glycerol.

UNIT III **10 Hrs**

Bioenergetics - Electron Transport Chain, Laws of Thermodynamics. Metabolism of Xenobiotics –Detoxification – Definition – Mechanism – Phase I Oxidation, Reduction, Hydrolysis –Phase II Conjugation Reaction - Glucuronic acid, Glutathione, Sulphate, Acetate and Methyl group.

Unit – IV **10 Hrs**

Laboratory Instruments and Records:

Code of ethics - maintenance of records and reporting – construction – care and use of the following Equipments and its applications: photoelectric colorimeter, spectrophotometer, Mass spectroscopy (GC – MSMS), LC-MSMS, MALDI-TOF, ICPMS. Electrophoresis, Biochemical analyzers and ELISA Reader.

Unit – V **15 Hrs**

Chromatography and Separation Principles

Types – paper chromatography, thin layer chromatography and HPTLC, Separation of phytoconstituents using TLC. Column chromatography - Ion exchange chromatography, affinity chromatography, gel filtration chromatography, Principle and application of gas chromatography, Sephadex columns. Low pressure liquid chromatography (LPLC) and High-Performance Liquid Chromatography (HPLC)- Normal and Reverse Phase Gas -liquid chromatography; Application and calibrations of analytical instruments (HPLC, GC and ICPMS) GC – MS library.

PRESCRIBED BOOKS:

1. Ambika Shanmugam: Fundamentals of Biochemistry for Medical Students.
2. Dubey R.C. (2008) A text Book of Biotechnology. S. Chand and Company, New Delhi
3. Satyanarayana. U. (2005) Biotechnology. Books and Allied P. Ltd. Kolkata.
4. Textbook of Medical Laboratory Technology: Ramnik Sood
5. Textbook of Medical Laboratory Technology: Kanai Mukherjee
6. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000
7. Weinberg, S. (2007). Good Laboratory Practice Regulations, 4th edition, CRC Press, U.S.A

REFERENCE BOOKS:

1. J.L. Jain: Fundamentals of biochemistry (1983).
2. Lehninger, A. L. (1970): Biochemistry, worth publishing co.,
3. Y. Lubert stryer: Biochemistry- (1975) Freeman and co.
4. D.W. Martin, P.A.Mayer and V.W. Redwell:Harper's Review Of biochemistry 19th edition (1983). Maruyen Asian Edition.
5. Manual on Medical Lab Technology: CMC Medical Foundation

E- LEARNING RESOURES

1. https://rgu-website.s3.ap-south-1.amazonaws.com.
2. https://www.si.mahidol.ac.th/department/biochemistry/home/SIBB501/integration_of_metabolism_web.pdf
3. https://conursing.uobaghdad.edu.iq/wp
4. https://www.youtube.com/watch?v=hbgq5IP1t4U
5. https://chemistry.unt.edu/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	3	2	1
III	2	2	1
IV	3	2	1
V	2	1	2
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**2**
CO 2	**3**	**3**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**2**	**3**	**3**	**3**	**3**
Ave.	**2.8**	**3**	**3**	**3**	**2.8**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the action of enzymes and enzyme kinetics	PSO1, PSO2, PSO3, PSO4,	K1, K2, K3, K4, K5, K6
CO2	Discuss them metabolic pathways in carbohydrate catabolism, protein metabolism and lipid metabolism.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Remember the basic principles of bioenergetics and their pathways.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Understand the protocols, procedures of Chromatography and Separation techniques.	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

GENETIC ENGINEERING AND BIOTECHNOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: ELECTIVE - 4**
COURSE NAME: GENETIC ENGINEERING AND BIOTECHNOLOGY	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 3	**TOTAL HOURS: 45**
THEORY	

COURSE OBJECTIVE:

To understand the principles and methods in genetic engineering and the role of Protein engineering.

COURSE OUTCOMES:

1. Acquire theoretical knowledge in the techniques, tools, application of restriction enzymes in genetic engineering.
2. Describe the detailed knowledge on vector sand its significant role in genetic engineering.
3. Understand the basic steps of gene cloning and the role of enzymes and gene transfer methods for identifying suitable hosts in cloning which responsible for gene manipulation, transformation and genetic engineering.
4. Discuss the analysis of recombinant DNA through various techniques such as PCR, Nucleic acid hybridization, Southern and Northern blotting etc.,
5. Remember the protein engineering and applications of genetic engineering in agriculture, health and industry include gene therapy.

UNIT I **10 Hrs**

Principles and methods in genetic engineering: Host cell restriction; Restriction Modification; Restriction enzymes: Types and applications; Restriction mapping; DNA finger printing; RFLP, RAPD and AFLP techniques; Nucleases, Ribonucleases, DNA ligases, Taq Polymerases, Methylases, Topoisomerases, Gyrases and Reverse Transcriptase's.

Vectors: Vectors: plasmid vectors: pSC101, pBR322, pUC series and Ti plasmids-based vectors; Bacteriophage vectors: Lambda phage-based vectors, phagemids, cosmids, and M13 based vectors; Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system; Bacterial artificial chromosome and yeast artificial chromosome. Expression vectors, Insect vectors.

UNIT II **10 Hrs**

Steps involved in genetic engineering – cDNA library & Genomic Library – Construction and Significance, Screening and Selection of recombinant genes.

DNA and protein sequencing - Hybridoma Technology, cell & tissue culture in plants & animals. Transgenic animals & plants.

Recombinant Technology - Polymerase chain reaction; Principles and techniques of nucleic acid hybridization and cot curves; Southern, Northern blotting techniques; Dot and Slot blotting.

Unit – III

Animal Biotechnology **10 Hrs**

Applications of Animal cell culture – Serum Protein Media Viability and Cytotoxicity, Equipment's and Media use for Animal Cell Culture Technology. Primary and established cell line culture and culture media**.**

Unit – IV **10 Hours**

Introduction to Industrial Bioprocess

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, Media Preparation.

Unit – V **5 Hours**

Application of biotechnology in Medicine and Health:

Diagnosis of diseases – analytical and instrumental methods, Production of Pharmaceuticals (hormones), Recombinant vaccines, Nutrigenomics, Stem cell Therapy.

PRESCRIBED BOOKS:

1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005. 2. Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
2. Balasubramanian, D. et al., "Concepts in Biotechnology" Universities Press Pvt. Ltd., 2004.
3. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001.
4. Dubey, R.C. "A Textbook of Biotechnology" S. Chand & Co. Ltd.
5. Ramadass P, Meera Rani S. Text Book of Animal Biotechnology. Akshara Printers, 1997

REFERENCE BOOKS:

1. Cruger, Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000
2. Moo-Young, Murrey, "Comprehensive Biotechnology".
3. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology.
4. K. G. Ramawat and Shaily Goyal, Comprehensive Biotechnology, 2009, S. Chand publications
5. Brown, C.M., Campbell, I. and Priest, F.G. (1988), Introduction to Biotechnology, Blackwell Scientific Publications, UK.
6. Primrose, S.B. (2000), Modern Biotechnology, Blackwell Scientific Publications, Oxford, London.
7. Keshav Trehan (1996), Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi.
8. Watson et.al. (1999) Recombinant DNA. Freeman and Company, New York.

E- LEARNING RESOURCES

1. https://www.mlsu.ac.in/econtents/65
2. http://www.eagri.org/eagri50/GPBR311/lec25.pdf
3. https://microbenotes.com/animal-cell-culture/
4. https://www.youtube.com/watch?v=5eKdZ0dVCCo
5. https://clintonwhitehouse4.archives.gov/media/pdf/chapter08.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	2
II	3	2	1
III	2	2	1
IV	3	2	1
V	2	1	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**2**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**3**	**3**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Acquire theoretical knowledge in the techniques, tools, application of restriction enzymes in genetic engineering	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Describe the detailed knowledge on vector sand its significant role in genetic engineering	PSO1, PSO2, PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO3	Understand the basic steps of gene cloning and the role of enzymes and gene transfer methods for identifying suitable hosts in cloning which responsible for gene manipulation, transformation and genetic engineering	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Discuss the analysis of recombinant DNA through various techniques such as PCR, Nucleic acid hybridization, Southern and Northern blotting etc.,	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Remember the protein engineering and applications of genetic engineering in agriculture, health and industry include gene therapy.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

PRACTICAL – 4
BIOCHEMISTRY, MEDICAL LAB TECHNOLOGY, BIOSTATISTICS AND RESEARCH METHODOLOGY

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: CORE PRACTICAL – 4**
COURSE NAME: BIOCHEMISTRY, MEDICAL LAB TECHNOLOGY, BIOSTATISTICS AND RESEARCH METHODOLOGY	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 180**

BIOCHEMISTRY

1. Estimation of protein by Lowry's method from fish tissues.
2. Estimation of carbohydrates by Anthrone method from fish tissues.
3. Estimation of lipids by Zak's method from fish tissues.
4. Amino acid detection by TLC method.
5. Blood: Clotting time and bleeding time.
6. Estimation of hemoglobin.
7. Erythrocyte Sedimentation Rate (ESR) – Chick.

MEDICAL LAB TECHNOLOGY

Analysis of Body fluids and Medical Microbiology

1. Preparation of reagents.
2. Microscopical examination of deposits.
3. Pregnancy tests - Sandwich Eliza Test by Pregnancy Kit method.
4. Examination of parasites in clinical specimens - Ova/parasites/cysts in faeces - Direct and concentration by Formal, Ether methods
5. Examination of parasites in clinical specimens - Ova/parasites/cysts in faeces Zinc sulphate - Saturated salt solution method.
6. Semen analysis.
7. Collection of samples for culture of microorganisms.
8. Different staining techniques, culture and sensitivity test.
9. Preparation of Blood smear for malarial and microfilaria analysis.
10. Identification of common arthropods of medical importance - spotters of Anopheles, Glossina, Phelbotomus, Aedes, etc. Ticks and mites.

STUDY TOUR

Report on the clinical and pathological laboratories through field visit.

BIOSTATISTICS

1. Collection, Classification and presentation of data relating to continuous and a discrete variable; obtaining descriptive measures for the collected data (each student shall collect separate primary data - a sample of at least 30 - such as length, weight etc. of fish, frog or any other animal, classify the data –graphically represent them - and obtain descriptive measures such as mean, standard deviation and standard error for the collected data.
2. Problems relating to testing goodness of fit
3. Problems relating to test of significance (Chi – Square test and student t-test)
4. Problems relating to Correlation.
5. 5Problems relating to Regression.

BIOTECHNOLOGY

1. Quantification and standard graph preparation using spectrophotometer.
2. Estimation of DNA by Diphenyl amine method.
3. Estimation of RNA by Orcinol method.
4. Electrophoresis - Paper / Agarose gel / PAGE
5. Western blotting (Demonstration).
6. Polymerase Chain Reaction (Demonstration).

EXTRA DISCIPLINARY ELECTIVE (EDE) COURSES

WILD LIFE MANAGEMENT

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: EXTRA DISCIPLINARY ELECTIVE – 1 (EDE 1)**
COURSE NAME: WILD LIFE MANAGEMENT	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 3	**TOTAL HOURS: 45**
THEORY	

COURSE OBJECTIVE:

To acquire the knowledge on observation of biosphere reserve and its fauna and flora.

COURSE OUTCOME:

1. Outline the common biomes of the world**,** biodiversity and wildlife resources in India.
2. Explain concepts and strategies for rare and endangered species for overabundant and invasive wildlife species as well as the role of Biosphere Reserves, National Parks, Wildlife Sanctuaries, Conservation Reserves, Community reserves, Sacred Habitats.
3. Express the major issues in wildlife conservation; National and International Protection Measures.
4. Describe the narrative of the changing relationship between humans and wildlife in India from precolonial to current times.
5. Relate wildlife census techniques, career paths, opportunities, and current and emerging issues for wildlife professionals.

UNIT-I **10 Hrs**

Wildlife habitat ecology: Biomes of the world – an overview; biome types of India: alpine tundra, grassland, forest, desert, aquatic and wetlands (unique features, distribution, vegetation, faunal make up and adaptations). Forest types of India.

Biodiversity and Wildlife Resources in India: Biodiversity of Indian subcontinent, Bio-geographical region in India, India as a mega diversity nation; India's National Biodiversity Action Plan, Biodiversity hotspot in India; Species conservation projects in India (Tiger, Rhino, Lion, Turtles, Crocodiles, Birds, Coral reefs).

UNIT-II **10 Hrs**

Scope and Importance of Wildlife of India: Definition of Wildlife: Causes of wildlife depletion; Threat of Wildlife; Economic importance of wildlife; Need for wildlife conservation; rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India

Species Conservation Techniques: In situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries, Conservation Reserves, Community reserves, Sacred Habitats), Ex-situ conservation (Botanical & Zoological Gardens, Gene Banks, Seed and Seedling Banks, Pollen Culture, Tissue Culture and DNA banks, Butterfly Gardening); Concept of Biodiversity Hotspots and Mega-diversity Country.

UNIT – III **5 Hrs**

National and International Protection Measures: Indian Wildlife (Protection) Act, 1972, Concept of Schedule in Wildlife Protection; Indian Biodiversity Act 2002; IUCN Red list of Threatened Species; The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

UNIT – IV **10 Hrs**

Human Wildlife Conflicts: Man-animal conflict in India; Human-wildlife Coexistence; Case studies – Elephant, gaur, wild boar, monkey, tiger and leopard; Translocation of Wild animals – Principles, Methods and applications. Eco-tourism; Wildlife Crimes, Sustainable Utilization of Biodiversity Resources.

UNIT – V **10 Hrs**

Wildlife Census Techniques: Planning census – Total counts - Sample counts – Basic concepts and applications - Direct count (block count, transect methods, point counts, pit fall, visual encounter survey, waterhole survey); Indirect count (Call count, track and signs, pellet count, pugmark, camera trap) - Identifying animals based on indirect signs; Capture-recapture techniques.

PRESCRIBED BOOKS:

1. Simmons, I.G. (1981). The Ecology of Natural Resources (II Edn), Edward Arnold Publishers. Ltd., Bedford Square, London.
2. Kapoor, V.C. (1995). Theory and Practice of Animal Taxonomy (III Edn) Oxford and IBH Publishing Co., New Delhi

REFERENCEBOOKS:

1. Global Biodiversity strategy (1992). Report by World Resources Institute (WRI). The Work
2. Conservation Union, and United Nations Environment Programme (UNEP).
3. Sinha, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.
4. Solbrig, O.T., Van Emden, H.M., and Van Oort, P.G.W.J. (1995). Biodiversity and
5. Global change. CAB International, Wallingford, U.K.

E-LEARNING RESOURCES:

1. Swarndeep S. Hundal 2004 Wildlife Conservation Strategies and Management in India: An Overview
2. V.B Sawarkar 2005 A Guide to Planning Wildlife Management in Protected Areas and Managed Landscapes
3. http://www.clemson.edu/psapublishing/pages/4h/sw448.pdf Economic importance of wildlife.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
			TOTAL	**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	2	1
II	2	1	2
III	2	2	1
IV	2	2	1
V	3	1	1
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**3**	**3**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**3**	**3**
CO 3	**2**	**2**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**
Ave.	**2.8**	**2.8**	**3**	**3**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Outline the common biomes of the world, biodiversity and wildlife resources in India.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Explain concepts and strategies for rare and endangered species for overabundant and invasive wildlife species as well as the role of Biosphere Reserves, National Parks, Wildlife Sanctuaries, Conservation Reserves, Community reserves, Sacred Habitats.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Express the major issues in wildlife conservation; National and International Protection Measures.	PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Describe the narrative of the changing relationship between humans and wildlife in India from precolonial to current times.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Relate wildlife census techniques, career paths, opportunities, and current and emerging issues for wildlife professionals.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

PUBLIC HEALTH AND HYGIENE

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: EXTRA DISCIPLINARY ELECTIVE – 2 (EDE 2)**
COURSE NAME: PUBLIC HEALTH AND HYGIENE	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 3	**TOTAL HOURS: 45**
THEORY	

COURSE OBJECTIVE:

To impart awareness on public health, Hygiene and diseases. To educate and emphasize on preventive measures of diseases. To create knowledge on Health Education.

COURSE OUTCOME:

1. Understand the different health indicators and classification of food.
2. Describe the environmental degradation through Air, Water, Land and Noise Pollution.
3. Acquire the knowledge on communicable diseases and their preventive and control measures.
4. Remember the importance of non-communicable diseases and their control.
5. Discuss the different health care programmes taken up by India.

UNIT I **5 Hrs**

Scope of Public health and Hygiene – nutrition and health – classification of foods – Nutritional deficiency diseases-Vitamin deficiency diseases.

UNIT II **10 Hrs**

Environment and Health hazards: Environmental degradation – Pollution – Air, Water, Land and Noise-associated health hazards- Hospital waste management.

UNITIII **10 Hrs**

Communicable diseases and their preventive and control measures. Measles, Polio Malaria, Hepatitis, Chikungunya, Rabies, Cholera, Filariasis, AIDS.

UNITIV **10 Hrs**

Non-Communicable diseases and their preventive measures. such as Hypertension, Coronary Heart Diseases, Stroke, Diabetes, Obesity and Alcoholism and drug dependence.

UNITV **10 Hrs**

Health Education in India – WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on epidemic, endemic, Pandemic and sporadic diseases.

PRESCRIBED BOOKS:

1. ParkandPark,1995: Text Book of Preventive and Social Medicine– Banarsidas Bhanot Publ. Jodhpur–India.

REFERENCEBOOKS:

1. Verma, S.1998: Medical Zoology, Rastogi publ. –Meerut–India
2. Singh, H.S. and Rastogi, P.2009: Parasitology, Rastogi Publ. India.
3. Dubey, R. Cand Maheswari, D.K.2007: Text Book of Microbiology-S. Chand & Co. Publ. New Delhi–India.

E-LEARNING RESOURCES:

1. https://www.vedantu.com/biology/health-and-hygiene
2. https://unacademy.com/content/kerala-psc/study-material/science-technology/environmental-hazards/
3. https://byjus.com/biology/communicable-disease-definition/
4. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases
5. https://en.wikipedia.org/wiki/Health_education

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (Each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 8 questions (Each in 300 words)	13 - 20	6	30
C	Answer any 4 out of 6 questions (Each in 1200 words)	21 - 26	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	2	2	1
III	3	2	1
IV	3	2	1
V	2	1	2
TOTAL	**12**	**8**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	**2**	**2**	**1**	**2**	**3**
CO 2	**2**	**2**	**3**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**
CO 4	**2**	**2**	**3**	**2**	**3**
CO 5	**2**	**2**	**3**	**3**	**3**
Ave.	**2**	**2**	**2.6**	**2.2**	**3**

PSO-CO-question paper mapping

	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the different health indicators and classification of food	PSO3	K1, K2, K3, K4, K5, K6
CO2	Describe the environmental degradation through Air, Water, Land and Noise Pollution	PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO3	Acquire the knowledge on communicable diseases and their preventive and control measures	PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO4	Remember the importance of non-communicable diseases and their control	PSO3, PSO5	K1, K2, K3, K4, K5, K6
CO5	Discuss the different health care programmes taken up by India	PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

SOFT SKILL COURSES

COMMUNICATION AND PRESENTATION SKILLS

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: SOFT SKILL - I**
COURSE NAME: COMMUNICATION AND PRESENTATION SKILLS	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVE:

To build communication skills for personal and professional development.

COURSE OUTCOMES:

1. Students will demonstrate the ability to listen to others actively, understand diverse perspectives, and paraphrase key points accurately, enhancing their comprehension skills in various personal and professional contexts.
2. Students will be able to articulate thoughts, ideas, and information clearly and concisely, using appropriate language and structure to convey messages effectively in both written and verbal communication.
3. Students will develop confidence in expressing opinions, asserting boundaries, and advocating for themselves and others, enhancing self-assurance and effectiveness in interpersonal and group communication.
4. Students will learn to adapt their communication style and approach based on the audience, context, and purpose of communication, fostering flexibility and versatility in interacting with diverse individuals and groups.
5. Students will acquire techniques for resolving conflicts, managing disagreements, and negotiating mutually beneficial outcomes through effective communication strategies, promoting constructive problem-solving and collaboration in personal and professional settings.

UNIT I Essentials of Effective Communication 6 Hrs

Communication Skills-LSRW- Characteristic features of LSRW-Consequences of Ineffective Communication-Impact of technology on Communication

UNIT II Types of Communication 6 Hrs

Verbal Communication – Non-verbal Communication- Visual Communication - Written Communication-Group Communication-Digital Communication-Formal and Informal Communication-Vertical-Horizontal-Diagonal Grapevine

UNIT III Barriers in Communication 6 Hrs

Physical Barriers - Language Barriers - Social and Cultural Barriers - Psychological Barriers - Semantic Barriers - Interpersonal Barriers - Technological Barriers- Means to overcome the various barriers to Communication

UNIT IV Etiquettes and Ethical Practices in Communication 6 Hrs

Active Listening - Clarity and Conciseness - Professional Tone - Timeliness - Constructive Feedback-Transparency-Professionalism-Accountability-Confidentiality-Cultural Sensitivity-Emotional Intelligence-Empathy-Social Intelligence-Social Etiquettes- Appreciation and Gratitude

UNIT V Presentation Skills 6 Hrs

Types of Presentation- Preparing a presentation-Do's and Don'ts while giving a presentation-Managing tools for presentation-Using Prompts-Making effective uses of Audio/Visual aids during presentation-Dealing with Questions, Interruptions and Pauses- Practical: Participating in Mock presentations

PRESCRIBED BOOKS

1. Monippally, Matthukutty, M. Business Communication Strategies. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2001.
2. Peter, Francis. (2012) Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill.
3. Raman, Meenakshi & Prakash Singh (2012) Business Communication Oxford University Press

REFERENCE BOOKS

1. Gallo, Maria. D (2018) Stop Lecturing Start Communicating: The Public Speaking Survival Guide for Business Kindle Edition
2. Hasson, Gill. (2012) Brilliant Communication Skills. Great Britain: Pearson Education.
3. Patil, Shailesh (2020) Handbook on Public Speaking, Presentation & Communication Skills: Principles & Practices to create high impact presentations & meaningful conversations, Chennai, Notion Press Media Pvt Ltd.

E-LEARNING RESOURCES

1. https://uwaterloo.ca/centre-for-teaching-excellence/catalogs/tip-sheets/effective-communication-barriers-and-strategies
2. https://www.coursera.org/articles/presentation-skills
3. https://positivepsychology.com/how-to-improve-communication-skills/

GUIDELINES FOR QUESTION PAPER SETTING

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	**10**
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	**20**
C	Answer any two (Internal - Choice)	14-15	10	**20**
	Internal & Viva Voce		50	**50**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL			
SECTION A - 12		**SECTION B - 6**	**SECTION C - 4**

PERSONALITY ENRICHMENT

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: SOFT SKILLS - II**
COURSE NAME: PERSONALITY ENRICHMENT	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVES:

To enable students to acquire and exhibit leadership qualities and work effectively by applying conflict resolution strategies and collaborative problem-solving.

COURSE OUTCOMES:

1. Students will demonstrate an understanding of various personality theories and assessments, leading to increased self-awareness.
2. Students will acquire effective verbal and non-verbal communication skills, including active listening and providing constructive feedback.
3. Students will exhibit leadership qualities, understand diverse leadership styles, and effectively work within teams by applying conflict-resolution strategies and collaborative problem-solving
4. Students will develop resilience, coping mechanisms, and stress reduction techniques to successfully navigate personal and academic challenges.
5. Students will demonstrate cultural intelligence, cross-cultural communication skills, and an understanding of global issues, fostering a sense of global citizenship.

UNIT I

Self-Actualization **6 Hrs**

SWOC Analysis- Self Regulation-Self Evaluation, Self-Monitoring, Self- Criticism, Self-Motivation, Self-awareness and Reflection: Reflective practices- Journaling and self-assessment exercises.

UNIT II

Interpersonal Skills **6 Hrs**

Effective Communication: Verbal and non-verbal communication - Active listening skills- Feedback and constructive criticism- Building Empathy and Emotional Intelligence: Negotiation Skills

UNIT III

Leadership and Teamwork **6 Hrs**

Leadership Skills: Leadership styles- Goal-setting and decision-making- Motivation and influence- Team Dynamics: Team building activities- Conflict resolution- Collaborative problem-solving

UNIT IV

Stress and Time Management **6 Hrs**

Definition of Stress, Types of Stress, Symptoms of Stress, Stress coping ability, Stress

Inoculation Training, Time Management and Work-Life Balance: Self-discipline Goal-setting

UNIT V

Cultural Competence and Global Awareness **6 Hrs**

Cultural Intelligence: Understanding diversity- Cross-cultural communication- Global citizenship and social responsibility- Ethics and Integrity: Personal and professional ethics- Decision-making in ethical dilemmas

PRESCRIBED BOOKS

1.Goleman, Daniel (2006) *Emotional Intelligence*, Bantam Books

2.Linden, Wolfgang (2004) *Stress Management From Basic Science to Better Practice*- University of British Columbia, Vancouver, Canada.

3.Richard L. Hughes; Katherine Colarelli Beatty; David L. Dinwoodie (2022) Becoming a Strategic Leader, Wiley

4.(2012) Leading with Cultural Intelligence Saylor Foundation

REFERENCEBOOKS

1. Meyer, Erin (2014) The Culture Map: Breaking Through the Invisible Boundaries of Global Business, Public Affairs.
2. Pittino, Daniel (2022) The Concise Leadership Textbook: Essential Knowledge and Skills for Developing Yourself as a Leader
3. Radtke, Laura (2022) Principles of Leadership & Management, Fanshawe College, Ontario
4. Wentz, Fredrick H. (2012) *Soft skills Training –A workbook to develop skills for employment*, Create Space Independent Publishing Platform.

E-LEARNING RESOURCES

1. https://www.helpguide.org/articles/stress/stress-management.htm
2. https://www.skillsyouneed.com/
3. https://greatergood.berkeley.edu/quizzes/take_quiz/stress_and_anxiety
4. https://www.switchboard.app/learn/article/teamwork-leadership-skills
5. https://kpu.pressbooks.pub/interculturalizingcurriculum/chapter/chapter-1/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	**10**
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	**20**
C	Answer any two (Internal - Choice)	14-15	10	**20**
	Internal & Viva Voce		50	**50**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL			
SECTION A - 12		**SECTION B - 6**	**SECTION C - 4**

EMPLOYABILITY SKILLS

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: III	**COURSE COMPONENT: SOFT SKILLS - III**
COURSE NAME: EMPLOYABILITY SKILLS	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVE:

To cultivate a comprehensive set of Employability Skills, encompassing both Technical Expertise and Soft Skills essential for Professional Success.

COURSE OUTCOMES:

1. Students will understand the overall advancement and development in the Global Job Market by envisaging its impact on prospective employees
2. Students will acquire the much-needed skill sets to prepare themselves to be competent and confident
3. Students will obtain global perspectives on diverse work cultures to handle different environments by not losing their individuality.
4. Students will focus on being mentally and physically fit in accomplishing their goals in their preferred workplaces.
5. Students will understand the proper drafting format of a Resume/CV and the different online portals available for job seekers.

UNIT I -Introduction to Global Perspectives in Employment 6 Hrs

Globalization- Market Expansion- Diversity and Inclusion- Competitive Advantage- Cultural Sensitivity- Adaptability- Innovation and Creativity- Risk Management- Career Advancement

UNIT II - Key Employability Skills in a Global Context 6 Hrs

Cross-cultural Communication- Language Proficiency- Flexibility- Global Awareness- Interpersonal Skills, Problem-solving and Critical Thinking- Teamwork- Global Business Acumen- Digital Literacy- Resilience and Persistence

UNIT III -Understanding Diverse Work Environments 6 Hrs

Diversity- Inclusive Practices- Communication Styles- Team Dynamics- Conflict Resolution- Cultural Sensitivity- Work Practices- Job Hopping- Moon Lighting- Training and Development- Leadership Commitment- Continuous Learning

UNIT IV -Employers' Expectations from Employees 6 Hrs

Job Competence- Required Skill Sets- Reliability and Accountability- Initiative and Proactivity- Adaptability and Flexibility- Teamwork and Collaboration- Professionalism and

Ethical Conduct, Customer Focus, Progressive Learning and Development- Adherence to Policies and Procedures, Contribution to Organizational Culture

UNIT V -Navigating International Job Markets 6 Hrs

Network Globally- Advertisements- Overseas Appointments- knowledge of International Labour Laws- Do's and Don'ts of Migrant Workers- Skilled Labour- Utilize Online Job Portals- Customize your Resume/CV- Preparedness for Remote Interviews and Assignments- Awareness: Health, Insurance, Foreign Exchange

PRESCRIBED BOOKS:

1. Covey, Stephen (2004) *Seven Habits of Highly Effective People: Powerful Lessons in Personal Change*, Free press.
2. Wiesinger, Susan & Ralph Beliveau (2023) *Digital Literacy: A Primer on Media, Identity, and the Evolution of Technology*

REFERENCE BOOKS

1. Hasson, Gill (2012) *Brilliant Communication Skills*. Great Britain: Pearson Education.
2. Trought, Frances. Dr. Brilliant (2017) *Employability Skills*, 2nd Edition Pearsons Business.
3. Soft Skills Training: A workbook to develop skills for employment, 2012
4. https://bharatskills.gov.in/pdf/EmployabilitNew.pdf

E-LEARNING RESOURCES

1. https://www.sydney.edu.au/careers/students/career-advice-and-development/employability-skills.html
2. https://www.careers.ox.ac.uk/develop-your-employability-skills
3. https://www.careers.ox.ac.uk/boosting-your-employability
4. https://builtin.com/diversity-inclusion/types-of-diversity-in-the-workplace
5. https://www.coursera.org/articles/employability-skills

.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	**10**
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	**20**
C	Answer any two (Internal - Choice)	14-15	10	**20**
	Internal & Viva Voce		50	**50**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL			
SECTION A - 12		**SECTION B - 6**	**SECTION C - 4**

ADVANCED COMPUTING PARADIGMS

PROGRAMME: M.Sc., ZOOLOGY	**BATCH: 2024-26**
PART: --	**COURSE COMPONENT: SOFT SKILL -IV**
COURSE NAME: ADVANCED COMPUTING PARADIGMS	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVES

To provide a deep understanding and practical experience in emerging methodologies in IT.

COURSE OUTCOMES:

1. Ability to do advance data processing using Excel.
2. Competency to represent data efficiently using Excel and Chat GPT
3. Adeptness to integrate AI Tools with Microsoft word and Microsoft Power point and to Translate documents using AI.
4. Skill to use the open source design tool Canva
5. Ability to efficiently visualize data using Tableau.

Unit – I **6 Hrs**

Excel: Cell Reference -Types of Cell Reference -Ranges, Named Ranges, Functions- Sum, Average, Max, Min, Count, Count A, Count Blank- Logical Functions- If and Nested If Functions, If with AND, OR, NOT, Count, If.

Unit – II **6 Hrs**

Conditional Formatting: PivotTables-Basic PivotTable Data, Insert a Pivot Table, Lookup Functions–Excel with Chat GPT.

Unit – III **6 Hrs**

AI Tools: Integrating Chat GPT in Microsoft Word, AI tool for PowerPoint Presentation - ANUVADINI: Voice & Document AI Translation Tools.

Unit – IV **6 Hrs**

Introduction to Open Source Design Tools - Canva: What is Canva? - Logging into Canva - Choosing a Carleton templates - Canva Editor - Open and edit your design - Using the Canva sidebar - Save and download your design piece - Share your design.

Unit – V **6 Hrs**

Tableau – Introduction- Adding Data Sources in Tableau – Data Types - Working with Measures and Dimensions – Working with Marks - - Creating Charts – Bar Chart – Line Chart- Maps.

References:

1. https://www.w3schools.com/excel/
2. https://anuvadini.aicte-india.org/
3. https://d31kydh6n6r5j5.cloudfront.net/uploads/sites/158/2020/06/Canva-Userguide.pdf
4. Tableau – Visual Analytics with Tableau – Alexander Loth.