

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**



**TWO YEAR POSTGRADUATE PROGRAMME**

**IN ZOOLOGY**

**FACULTY: SCIENCE AND TECHNOLOGY**

**M.Sc. II SEM III & IV (NEP)**

**(Courses effective from Academic Year 2024-25)**

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**TWO YEAR POSTGRADUATE PROGRAMME**  
**M.Sc. ZOOLOGY under FACULTY: SCIENCE AND TECHNOLOGY**  
**Board of Studies in Zoology (Including Apiculture)**

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<b>Patil Dr. P.S.</b> R.A. Arts, Shri M.K. Commerce and S.R. Rathi Science College, Washim.	<b>Sapkal Dr. Hemant P.</b> Shri Shivaji Arts, Commerce and Science College, Akola.
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**Sant Gadge Baba Amravati University Amravati**

**FACULTY: SCIENCE AND TECHNOLOGY**

**Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science (Zoology) following Three Years UG Programme w.e.f. 2023-24**

**(Two Years-Four Semesters Master's Degree Programme-NEP v23 with Exit and Entry Option**

**M.Sc. (Zoology) Second Year Semester-III [Level 6.5]**

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme								
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing			
				L	T	P	Total	L/T	Practical	Total		Theory		Practical		Total Marks	Marks Internal	Marks External	Grade	
												Theory +MCQ Internal	Theory External	Internal	External					
1	DSC-I.3 Molecular Cytogenetics	Th-Major	3 ZOO 1	4	-	-	4	4		4	3	40	60			100	16	24	P	
2	DSC-II.3 Population, Quantitative and Evolutionary Genetics	Th-Major	3 ZOO 2	4	-	-	4	4		4	3	40	60			100	16	24	P	
3	DSC-III.3 Endocrinology	Th-Major	3 ZOO 3	3	-	-	3	3		3	3	40	60			100	16	24	P	
4	DSE-III: Entomology-I/ Fishery -I/ Animal physiology-I/ Molecular Biology-I	Th-Major Elective	3 ZOO 4	3	-	-	3	3		3	3	40	60			100	16	24	P	
																	Minimum Passing Marks			
5	DSC I.3 and DSC II.3.(Lab 5)	Pr-Major	3 ZOO 5	-	-	4	4		2	2	6			50	50	100	50		P	
6	DSC-III.3.and DSE III (Lab 6)	Pr-Major	3 ZOO 6	-	-	4	4		2	2	6			50	50	100	50		P	
7	Research Project Phase-I	Major		-	2	4	6	2	2	4				50	--	50	25		P	
8	Co-curricular Courses: Health and wellness, Yoga Education, Sports and fitness, Cultural Activities, NSS/ NCC, Fine / Applied/ Visual/ Performing Arts During Semester I, II, III and IV	Generic Optional		90 Hours Cumulatively From SEM I to SEM IV																
	<b>TOTAL</b>									22						650				

**L: Lecture, T: Tutorial, P: Practical / Practicum**

Pre-requisite Course mandatory if applicable: **Prq**, Theory: **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT**: On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM**: Research Methodology, Research Project: **RP**, **Co-curricular Courses**: **CC**.

Note: **Co-curricular Courses**: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, Startups, Hackathon, Quiz competitions, Article published, Participation in Summer school /Winter School /Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online /offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eye sight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV**. **Its credits and grades will be reflected in semester IV credit grade report.**

**Sant Gadge Baba Amravati University Amravati**  
**FACULTY: SCIENCE AND TECHNOLOGY**

**Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science (Zoology) following Three Years UG Programme w.e.f. 2023-24**  
**(Two Years-Four Semesters Master's Degree Programme-NEP v23 with Exit and Entry Option**  
**M.Sc. (Zoology) Second Year Semester-IV [Level 6.5]**

S.N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme								
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing			
				L	T	P	Total	L/T	Practical	Total		Theory		Practical		Total Marks	Marks Internal	Marks External	Grade	
												Theory +MCQ Internal	Theory External	Internal	External					
1	DSC-I.4 Biochemistry	Th-Major	4 ZOO 1	4	-	-	4	4		4	3	40	60			100	16	24	P	
2	DSC-II.4 Enzymology and Biostatistics	Th-Major	4 ZOO 2	4	-	-	4	4		4	3	40	60			100	16	24	P	
3	DSC-III.4 General Parasitology	Th-Major	4 ZOO 3	3	-	-	3	3		3	3	40	60			100	16	24	P	
4	DSE-IV: Entomology-II/ Fishery -II/ Animal physiology-II/ Molecular Biology-II/	Th-Major Elective	4 ZOO 4	3	-	-	3	3		3	3	40	60			100	16	24	P	
																	<b>Minimum Passing Marks</b>			
5	DSC I.4 and DSC II.4.(Lab 7)	Pr-Major	4 ZOO 5	-	-	4	4		2	2	6			50	50	100	50		P	
6	DSC-III.4.and DSE IV (Lab 8)	Pr-Major	4 ZOO 6	-	-	4	4		2	2	6			50	50	100	50		P	
7	Research Project Phase-II	Major		-	2	8	10	2	4	6	3			75	75	150	75		P	
8	Co-curricular Courses: Health and wellness, Yoga Education, Sports and fitness, Cultural Activities, NSS/ NCC, Fine / Applied/ Visual/ Performing Arts During Semester I, II, III and IV	Generic Optional		<b>90 Hours Cumulatively From SEM I to SEM IV</b>																
	<b>TOTAL</b>										<b>24</b>						<b>750</b>			

**L: Lecture, T: Tutorial, P: Practical / Practicum**

Pre-requisite Course mandatory if applicable: **Prq**, Theory: **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT**: On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM**: Research Methodology, Research Project: **RP**, **Co-curricular Courses**: **CC**.

Note: **Co-curricular Courses**: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, Startups, Hackathon, Quiz competitions, Article published, Participation in Summer school /Winter School /Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online /offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eye sight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

**Sant Gadge Baba Amravati University, Amravati**  
**Name of the Programme: M.Sc. (SEM-III) Subject: Zoology (NEPv23)**

**POs:**

The post graduate course of Zoology will provide theoretical as well as experimental knowledge as per the courses included under the syllabi by which build up creativity in students will lead towards thorough learning and development of ideas of research work and will become ready to face recent challenges. Students can attain the employability skills through the experiences based on their practical knowledge.

**After completion of MSc in Zoology successfully, the students would be able to.....**

1. Demonstrate the significance of the topics of syllabi and evaluate its relevance. Think creatively for its gravity and develop ideas.
2. Interpret scientific ideas and can do its analysis. Create experiments independently and draw inferences by sharing it with others.
3. Derive information from various digital sources. Develop skills for scientific writing and present the data and analyse it scientifically.
4. Articulate scientific ideas lay down a hypothesis; design the pathway to develop research ideas.
5. Acquaint skills in handling the instruments and different techniques through practicals and developing the scientific temperaments for research.
6. Develop competence through healthy atmosphere and quality intercommunication with different groups.
7. Understand environmental and sustainability issues and its sensitivity in relation to regional relevance.
8. Get the facility of different training and internship programs through job-oriented curriculum
9. Utilize the sources confidently and independently and develop self-sustenance.

**PSOs:**

**Upon completion of the Programme successfully, students would be able to .....**

1. Learn to prepare the checklist and inventories through the identification of the fauna in local areas being Melghat Tiger Reserve and Pohra Forest are very nearer to survey.
2. Gain comprehensive knowledge about different animals and develop confidence to handle them during research work.
3. Interpret metabolic pathways, their correlation in concern with prokaryote and eukaryotes.
4. Compare genetic aspects, genetic traits, diseases and their specific causes.
5. Survey and analyse data of the various kinds of diseases in the locality.
6. Understand various strategies and phenomena related to animal reproduction and their development.
7. Get acquainted with conservation strategies and environmental threats to reduce and save energy through Wildlife Week Celebration.
8. Compare the different developmental events during embryogenesis of different animals.

**EMPLOYABILITY POTENTIAL**

- After Completion of this course Field Biologist or Ecologist in different govt. establishments like NTCA, Division Office, Wildlife Wings Wildlife Consultant EIA Report Designing Firm,
- Wildlife Conservation Educator in NGOs like WWF, WCT, WTI, Conservation Geneticist in research organisations,
- GIS Specialist in Govt Establishments, Environmental Impact Assessment (EIA) Specialist: Assessing the potential impact of development Projects on wildlife and proposing mitigation measures.

- Wildlife Forensics Specialist in research labs
- Research Associate or Assistant: Assisting senior researchers in wildlife conservation projects and Data analysis.
- Wildlife Photographer or Filmmaker: Using visual media to raise awareness about wildlife Conservation and natural habitats.
- Wildlife Tour Guide or Naturalist: Conducting guided tours in wildlife sanctuaries, national parks, or Eco-tourism sites.
- Wildlife Project Manager: Overseeing and coordinating conservation projects aimed at protecting Specific wildlife species or habitats.
- Environmental Educator: Developing and delivering educational programs related to wildlife Conservation and environmental protection.
- Environmental Scientists, Ecologist, Environmental manager, scientific technical writer, zoo manager, Lab technician

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### Examination, Evaluation and Assessment Scheme

#### 1. External Theory Examination - 60 Marks (Minimum Passing Marks = 24)

Question Paper Pattern (for example)			
Unit No.	Question No.	Question Type for Unit	Marks
		a) Long answer question.	10
		OR	
		b) Long answer question.	10
		c) Short answer question.	05
		d) Short answer question.	05
		OR	
		e) Short answer question.	05
		f) Short answer question.	05

#### 2. Internal Assessment Marks (Theory) - 40 Marks

- Internal assessment marks (Theory) shall be based on two class tests (20 marks each), student will have to score at least 40 % Marks, that is, 16 Marks for passing the theory internal course.
- In case, even after completing the requisite term-work, the student is unable to score minimum prescribed marks in Internal Theory Examination, that is, 16, he/she will be declared as Fail.
- Now, MCQ, if any, will be part of the Internal Assessment only.
- However, the concerned college/institute/university department shall give one more opportunity to such failure students.
- Thus, failure students will get another chance to clear their theory courses/subjects.
- The remedial re-examination of such failure students shall be conducted before the commencement of end-semester university examinations, so that the concerned college/institute/university department can submit the revised internal marks of such failure students to the University in due course of Time as instructed by the university.

**M. Sc. Zoology (NEPv23) Semester-III**

<b>Course: DSC I.3 Molecular Cytogenetics Th- Major</b>		
<b>Subject Code: 3 ZOO 1</b>	<b>No. of Credits: 4</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 3 Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 60</b>

**COs: 3 ZOO 1**

1. Students acquire knowledge about the mutation and different causes of mutation.
2. The student gain in-depth knowledge regarding transposition mechanisms in prokaryotes and eukaryotes, and their significance.
3. Special features of microbial genetics, and organelle genome, their replication and mapping.
4. The student gain an in depth knowledge regarding the events and regulation of cell cycle, its alteration and causes of cancer. Genes involved in the regulation of cancer.

<b>Unit</b>	<b>Contents</b>	<b>Hours</b>
<b>Unit-I</b>	<p><b>Mutation:</b></p> <p>1.1 Mutation induced by chemicals and radiation.</p> <p>1.2 Mutation caused by DNA replication machinery.</p> <p>1.3 Hot spots of mutation.</p> <p>1.4 Detection of mutagens-The Ames Test.</p> <p>1.5 DNA repair mechanisms.</p>	<b>10</b>
<b>Unit-II</b>	<p><b>Somatic Cell Hybridization:</b></p> <p>2.1 Agents of cell fusion, Mechanism of cell fusion, Selection of hybrids.</p> <p>2.2 Radiation hybrid panels and gene mapping.</p> <p><b>Epigenetics:</b></p> <p>2.3 Mechanisms of histone modification.</p> <p>2.4 Prions and epigenetic inheritance.</p> <p>2.5 Polycomb mechanisms and epigenetic control of gene activity.</p>	<b>10</b>
<b>Unit-III</b>	<p><b>Transposable Genetic Elements:</b></p> <p>3.1 Transposable elements in bacteria, <i>Drosophila</i> and humans.</p> <p><b>Genetics of Cancer:</b></p> <p>3.2 Properties of cancer cells.</p> <p>3.3 Metastasis.</p> <p>3.4 Oncogenes.</p> <p>3.5 Tumor suppressor genes.</p>	<b>10</b>
<b>Unit-IV</b>	<p><b>Human Genetic Diseases and Disorders:</b></p> <p>4.1 <b>Diseases Caused Due to Numerical Abnormalities of Chromosomes:</b> Edwards syndrome, Down syndrome, Turner syndrome, Klinefelter syndrome.</p> <p>4.2 <b>Diseases Caused Due to Structural Abnormalities of Chromosomes:</b> Cri-du-chat syndrome, Prader-Willi syndrome.</p> <p>4.3 <b>Human Metabolic Disorders:</b> Phenylketonuria, Lesch-Nyhan syndrome, Tay-Sachs disease,</p> <p>4.4 <b>Other Genetic Diseases:</b> Duchenne muscular dystrophy, Sickle cell anemia, Thalassaemia, Alzheimer's disease, Parkinson's disease.</p> <p>4.5 Diseases Caused Due to Defects in Mitochondrial DNA.</p>	<b>10</b>
<b>Unit-V</b>	<p><b>Bacterial Genetics:</b></p> <p>5.1 Bacterial transformation, conjugation and transduction.</p>	<b>10</b>



	<p><b><i>Drosophila</i> Genetics:</b></p> <p>5.2 <b>Polytene Chromosomes:</b> Polytenization process and its significance, Regulation of puffing activity.</p> <p>5.3 <b>Behavioral Genetics:</b> Mutants, Behavioural traits, Genetic and molecular basis of biological rhythm.</p> <p><b>Extra-chromosomal Inheritance:</b></p> <p>5.4 Maternal inheritance of <i>kappa</i> particles in <i>Paramecium</i>, Shell coiling in <i>Lymnaea</i>.</p>	
<b>Unit-VI</b>	<p><b>Molecular Cytogenetic Techniques:</b></p> <p>6.1 Human karyotyping.</p> <p>6.2 Flow cytometry (for chromosome separation).</p> <p>6.3 Chromosome painting.</p> <p>6.4 Fluorescence <i>in situ</i> hybridization (FISH).</p> <p>6.5 <b>DNA Fingerprinting:</b> Principle, procedure and applications.</p>	<b>10</b>

**Suggested Readings:**

1. Ahluwalia, K. Genetics. 2/Ed. New Age International Publishers.
2. Allis, C. David Epigenetics. Cold Spring Harbor Laboratory Press.
3. Atherly, A.G., J. R. Girton and J.F. McDonald. The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, NY.
4. Brooker, R.J. Genetics-Analysis and Principles,6/Ed. McGraw-Hill Education.
5. Brown, T. A. Genetics-A Molecular Approach, 3/Ed. Garland Science.
6. Dale, Jeremy W. et al. Molecular Genetics of Bacteria, 5/Ed. Wiley-Blackwell.
7. Fairbanks, D. J. and W. R. Anderson. Genetics – The continuity of Life. Brooks/Cole Publishing Company ITP, NY, Toronto.
8. Griffiths, A.J.F. et al. 12/Ed. An Introduction to Genetic Analysis. W.H. Freeman and Company.
9. Hartl, D. L and E. W. Jones: Analysis of Genes and Genomes, 7/Ed. Jones & Bartlett Pub.
10. Hartwell, Leland H. Genetics- From Genes to Genomes, 6/Ed. McGraw-Hill Education.
11. Holt Ian. J. Genetics of Mitochondrial Disease. Oxford University Press.
12. Klug, William S. *et al.* Concepts of Genetics, 12/Ed. Pearson Education, Inc.
13. Krebs, J. E. *et al.* Lewin’s Genes XII. Jones and Bartlett Pub.
14. Lewis Ricki. Human Genetics-Concepts and Applications, 12/Ed. McGraw-Hill Education.
15. Mange E. J. and A. P. Mange. Basic Human Genetics 2/Ed. Sinauer Associates.
16. Miglani, Gurbachan S. Essentials of Molecular Genetics. Alpha Science International Ltd.
17. Nussbaum Robert L. *et al.* Genetics in Medicine 7/Ed. Saunders, Elsevier Inc.
18. Pasternak Jack J. An Introduction to Human Molecular Genetics, 2/Ed. John Wiley & Sons.
19. Pierce Benjamin A. Genetics-A Conceptual Approach, 7/Ed. W.H. Freeman and Company, New York.
20. Rimoin, D. L. *et al.* Principles and Practice of Medical Genetic, 6/Ed.
21. Russell, P. J. *i*Genetics, 3/Ed. Pearson Education, Inc.
22. Schaaf Christian P. *et al.* Human Genetics-From Molecules to Medicine. Wolters Kluwer.
23. Snustad, D. Peter and M.J. Simmons. Principles of Genetics, 7/Ed. Wiley-Blackwell.
24. Strachan Tom and Andrew Read. Human Molecular Genetics, 4/Ed. Garland Science.
25. Strickberger, M. W. Genetics. Pearson Education, Inc.
26. Tollefsbol, T. Handbook of Epigenetics: The New Molecular and Medical Genetics.
27. Turnpenny Peter D. *et al.* Emery’s Elements of Medical Genetics, 15/Ed.
28. Vogel, F. and A.G. Motulsky. Human Genetics. Springer-Verlog, NY
29. Weaver, R.F. & P. W. Hedrick: Genetics 3/Ed. Wm. C. Brown Pub. London.
30. Wright Alan and Nicholas Hastie. Genes and Common Diseases. Cambridge University Press.

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<b>Course: DSC II.3 Population, Quantitative and Evolutionary Genetics Th- Major</b>		
<b>Subject Code: 3 ZOO 2</b>	<b>No. of Credits: 4</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 3 Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 60</b>

**COs: 3 ZOO 2**

1. Student understand the concept of Genetic Structure of Populations.
2. Gaining knowledge of forces changing the gene frequency.
3. Learn methods of construction of phylogenetic tree and methods to retrieve the nucleotide sequences.
4. Understand the quantitative genetics and several factors influencing the quantitative traits.

<b>Unit</b>	<b>Contents</b>	<b>Hours</b>
<b>Unit-I</b>	<b>Population Genetics: Genetic Structure of Populations-</b> 1.1 Genotype frequencies. 1.2 Allele frequencies. 1.3 Hardy–Weinberg principle. 1.4 Applications of Hardy-Weinberg principle. 1.5 Exceptions to Hardy-Weinberg principle. 1.6 Consanguineous mating and its consequences.	<b>10</b>
<b>Unit-II</b>	<b>Population Genetics: Forces Changing Gene Frequencies-</b> 2.1 Nonrandom mating. 2.2 Mutation. 2.2 Migration. 2.3 Genetic drift. 2.4 Natural selection. 2.5 Balance between mutation and selection.	<b>10</b>
<b>Unit-III</b>	<b>Quantitative Genetics:</b> 3.1 Quantitative traits. 3.2 Factors influencing quantitative traits. 3.3 Molecular analysis of quantitative trait loci. 3.4 Genotype-environmental interactions. 3.5 Inbreeding depression and heterosis.	<b>10</b>
<b>Unit-IV</b>	<b>Evolution:</b> 4.1 Theories of Evolution: Lamarck’s theory, Neo-Lamarckism, Darwin’s theory, Neo-Darwinism, Hugo de Vries Mutation theory, Modern synthetic theory. 4.2 Origin of basic organic monomers and polymers, Miller-Urey experiment. 4.3 Origin of organized structures-coacervates and microspheres. 4.4 Geological time-scale.	<b>10</b>
<b>Unit-V</b>	<b>Evolutionary Genetics:</b> 5.1 Genetic variation in natural populations. 5.2 Nucleotide substitution in DNA sequences. 5.3 Rates of nucleotide substitutions. 5.4 Variation in evolutionary rates between genes. 5.5 Rates of evolution in mitochondrial DNA. 5.6 Molecular clocks.	<b>10</b>

<b>Unit-VI</b>	<p><b>Molecular Phylogenetics:</b></p> <p>6.1 Features of phylogenetic trees.</p> <p>6.2 Methods of phylogenetic tree reconstruction.</p> <p>6.3 Nucleic acid phylogeny based on DNA-DNA hybridization, Restriction Enzyme sites, and Nucleotide sequence comparisons and homologies.</p> <p>6.4 Acquisition and Origin of New Genes: Multigene families, Gene duplication and gene conversion.</p> <p>6.5 Protein phylogeny.</p>	<b>10</b>
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**Suggested Readings:**

1. Brooker, R.J. **Genetics-Analysis and Principles**, 6/Ed. McGraw-Hill Education.
2. Brown, T. A. **Genomes 4**. Garland Science.
3. Futuyma, Douglas J. and Mark Kirkpatrick. **Evolution**, 4/Ed. Sinauer Associates, Inc.
4. Griffiths, A.J.F. *et al.* **An Introduction to Genetic Analysis**, 12/Ed. W.H. Freeman and Company.
5. Hall Brian K. and Benedikt Hallgrimsson. **Strickberger's Evolution**, 2-5/Ed. John and Bartlett Learning.
6. Hartl, D. L and E. W. Jones. **Analysis of Genes and Genomes**, 7/Ed. Jones & Bartlett Pub.
7. Hartl, D. L. **Essential Genetics and Genomics**, 7/Ed. Jones & Bartlett Pub.
8. Hartl, Danil L. and Andrew J. Clarke. **Principles of Population Genetics**. Oxford University Press Inc.
9. Khatib Hasan. **Molecular and Quantitative Animal Genetics**. Wiley Blackwell.
10. Klug, William S. *et al.* **Concepts of Genetics**, 12/Ed. Pearson Education, Inc.
11. Krebs, J. E. *et al.* **Lewin's Genes XII**. Jones and Bartlett Pub.
12. Lewis Ricki. **Human Genetics-Concepts and Applications**, 12/Ed. McGraw-Hill Education.
13. Meneely Philip, *et al.* **Genetics-Genes, Genomes and Evolution**. Oxford University Press.
14. Pierce Benjamin A. **Genetics-A Conceptual Approach**, 7/Ed. W.H. Freeman and Company, New York.
15. Rafael Maia. **Population Genetics**. Intech Open Publishers UK.
16. Relethford, John H. **Human Population Genetics**. Willey-Blackwell Publisher.
17. Russell, P. J. **iGenetics**, 3/Ed. Pearson Education, Inc.
18. Smith, John Maynard. **Evolutionary Genetics**, 2/Ed. Oxford University Press.
19. Snustad, D. Peter and M.J. Simmons. **Principles of Genetics**, 7/Ed. Wiley-Blackwell.
20. Strachan Tom and Andrew Read. **Human Molecular Genetics**, 4/Ed. Garland Science.
21. Verma, P. S. and V. K. Agarwal. **Cell Biology, Genetics, Molecular Biology, Evolution and Ecology**. S. Chand and Company Ltd.
22. Vogel, F. and A.G. Motulsky. **Human Genetics**. Springer-Verlog, NY.

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<b>Course: Pr- Major Laboratory 5</b>		
<b>(DSC I.3- Molecular Cytogenetics + DSC II.3 - Population, Quantitative and Evolutionary Genetics)</b>		
<b>Subject Code: 3 ZOO 5</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100 (External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for Molecular Cytogenetics**

1. Demonstration of Barr bodies in leucocytes of human female.
2. Demonstration of salivary gland chromosomes from Chironomous/Drosophila larvae.
3. Study of mitosis in cleaving eggs of Frog/any invertebrate.
4. Histological demonstration of meiosis in mammalian testis.
5. Preparation of human karyotype using photograph/picture.
6. Culture of Drosophila and study of life cycle and sexual polymorphism.
7. Identification of wing and eye mutants in Drosophila.
8. Extraction of DNA.
9. Estimation of DNA (spectrophotometric/colorimetric).
10. Extraction of RNA.
11. Estimation of RNA (spectrophotometric/colorimetric).
12. Problems on Genetics based on dihybrid crosses, sex-linked inheritance and blood groups.
13. Study of human genetic traits.

**B) Practicals for Population, Quantitative and Evolutionary Genetics:**

1. Problems based on calculation of gene/allele frequencies using Hardy-Weinberg Principle.
2. Retrieval of DNA/protein sequences from databases.
3. Biological sequence editing.
4. Sequence alignment: database searches (BLAST, FASTA).
5. Phylogenetic tree construction.
6. Analysis of phylogenetic tree.

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) Molecular Cytogenetics**

1. Estimation/Experiment..... 10 marks
2. Cytological Preparation ..... 05 marks
3. Problem on Genetics.....05 marks

**Experiments from Section B) Population, Quantitative and Evolutionary Genetics**

4. DNA/protein sequence alignment/PT tree construction.....10 Marks
5. Retrieval of DNA/protein sequences from database.....05 Marks
6. Problem based on H-W principle.....05 Marks
7. Viva Voce .....10 Marks

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**TOTAL**

**50 Marks**

**Internal Practical Marks**

1. Certified Practical Record : 20 marks
2. Submission of Stained Permanent slides : 10 marks
3. Submission of phylogenetic tree : 10 marks
4. Student Performance : 10 marks

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**TOTAL**

**50 Marks**

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Course: DSC III.3 Endocrinology Th- Major		
Subject Code: 3 ZOO 3	No. of Credits: 4	No. of hours per week: 4
Exam duration: 3 Hrs	Maximum Marks: 100 (External:60 Internal:40)	Total No. of contact hours: 60

**COs: 3 ZOO 3**

1. Describe types of hormones and their action at cellular and genetic level
2. Identify the type of hormone on the basis of its action.
3. Identify various parts of important endocrine glands and describe the role of their hormones.
4. Describe hormonal interplay during metamorphosis

Unit	Contents	Hours
<b>Unit-I</b>	<b>Anatomy, Histology and Hormones of Vertebrate Endocrine Glands:</b> 1.1 Pituitary, Thyroid, Parathyroid, Adrenal, Pineal gland and Islets of Langerhans. 1.2 Endocrine placenta, testis and ovary. 1.3 Ultimobranchial glands. 1.4 Urophysis and Corpuscles of Stannius in fishes. 1.5 Hormones from hypothalamus.	<b>10</b>
<b>Unit-II</b>	<b>Classification and Biosynthesis of Hormones:</b> 2.1 Evolution of hormones. 2.2 Classification of Hormones (peptides, steroids and amino acid derived). 2.3 Biosynthesis of steroid hormones. 2.4 Biosynthesis of T3, T4 and epinephrine. 2.5 Biosynthesis of peptide hormones. 2.6 Hormone secretion, transport, and clearance from the Blood.	<b>10</b>
<b>Unit-III</b>	<b>Action and Functions of Hormones:</b> 3.1 Hormone action at membrane level (Ex. Insulin). 3.2 Hormone action at genetic level (Ex. Testosterone). 3.3 Hormones in digestion. 3.4 Hormonal regulation of carbohydrate, lipid and protein metabolism. 3.5 Hormonal regulation of growth and reproduction. 3.6 <b>Other hormones and their Functions:</b> Renin, Angiotensin, Atrial Natriuretic Factor (ANF), and Erythropoietin.	<b>10</b>
<b>Unit-IV</b>	<b>Endocrine Disorders:</b> 4.1 Thyroid hormones and disorders. 4.2 Parathyroid hormones and disorders. 4.3 Pituitary hormones and disorders. 4.4 Adrenal hormones and disorders. 4.5 Endocrine changes in pregnancy. 4.6 <b>Diabetes:</b> Causes of Type I and Type II Diabetes, Effects of Diabetes (Retinopathy, Neuropathy and Nephropathy), Gestational Diabetes.	<b>10</b>
<b>Unit-V</b>	<b>Therapeutic and Behavioral Endocrinology:</b> 5.1 Hormone replacement therapy. 5.2 Risks and benefits of hormone replacement therapy. 5.3 Transfeminine and transmasculine hormone therapy 5.4 Hormones and social behavior. 5.5 Hormones and parental behaviour.	<b>10</b>

<b>Unit-VI</b>	<p><b>Other Aspects of Endocrinology:</b></p> <p>6.1 Effect of athletic performance on hormonal systems.</p> <p>6.2 Performance-enhancing (Ab) use of hormones.</p> <p>6.3 Adipose tissue as an endocrine organ.</p> <p>6.4 Hormonal control of Crustacean metamorphosis.</p> <p>6.5 Hormonal control of Insect metamorphosis.</p>	<b>10</b>
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**Suggested Reading:**

1. Bentley, P.J. Comparative Vertebrate Endocrinology, 2/Ed. Cambridge University Press.
2. Dattani Mehul T. (Editor). Brook's Clinical Pediatric Endocrinology, 7/Ed. Wiley.
3. Dubey Raghvendra K. Sex Hormones. InTech.
4. Gardner David G and Dolores Shoback. Basic and Clinical Endocrinology, 9/Ed. McGraw Hill Medical.
5. Goodman H. Maurice. Basic Medical Endocrinology, 4/Ed. Academic Press.
6. Greenspan, Francis S. and David G. Gardner. Basic and Clinical Endocrinology, 7/Ed. Lange.
7. Hadley, Mac E. Endocrinology, 3/Ed. Prentice Hall.
8. Hall John E. Guyton and Hall Textbook of Medical Physiology, 1/Ed. Elsevier, Inc.
9. Holt Richard IG and Neil A Hanley. Essential Endocrinology and Diabetes, 6/Ed. Wiley-Blackwell.
10. Ilie, Ioana R. Introduction to Endocrinology. Springer.
11. Jameson J. Larry. Harrison's Endocrinology, 4/Ed. McGraw Hill Education.
12. John Laycock and Karim Meeran. Integrated Endocrinology. Wiley-Blackwell.
13. Lifshitz Fima (Editor). Pediatric Endocrinology, 5/Ed. Informa Healthcare.
14. Marc A. Fritz and Leon Speroff. Clinical Gynecologic Endocrinology and Infertility, 8/Ed. Wolters Kluwer-Lippincott Williams and Wilkins.
15. Melmed Shlomo *et al.* Williams Textbook of Endocrinology, 14/Ed. Elsevier, Inc.
16. Molina Patrica. Endocrine Physiology, 5/Ed. McGraw Hill Education.
17. Neave Nick. Hormones and Behavior. Cambridge University Press.
18. Norman Anthony W. and Gerald Litwack. Hormones, 2/Ed. Academic Press.
19. Norman Lavin. Manual of Endocrinology and Metabolism, 5/Ed. Wolters Kluwer.
20. Norris David O. Vertebrate Endocrinology, 4/Ed. Elsevier, Inc.
21. O' Nill Murphy. Endocrinology, Mosby-Elsevier.
22. O'Malley Bert W. (Editor). Hormones and Signaling, Vol. I., Academic Press.
23. Oxford Textbook of Endocrinology and Diabetes, 2/Ed. Oxford University Press.
24. Sachdev Y. (Editor). Clinical Endocrinology and Diabetes Mellitus. Jaypee Brothers Medical Publishers (P) Ltd.
25. Stephen Nussey and Saffron Whitehead. Endocrinology- An Integrated Approach. Bios Scientific Publisher.
26. Strauss, Jerome F. and Robert L. Barbieri. Reproductive Endocrinology. Elsevier.

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<b>Course: DSE III Entomology-1 Th- Major Elective-I (Insect Classification, Morphology and Physiology)</b>		
<b>Subject Code: 3 ZOO 4</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3 Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

**CO's: 3 ZOO 4**

- 1: Students are trained in the basics of insect classifications.
- 2: Insect anatomy of various insects are studied in detail.
- 3: Insect physiology of various insects are studied in detail.
- 4: Acquire an understanding of insect metamorphosis process.

<b>Units</b>	<b>Syllabus Content</b>	<b>Hours</b>
<b>Unit I</b>	<p><b>Insect classification</b></p> <p>1.1 Classification of class insecta (class, subclass, orders with examples).</p> <p>1.2 Distinguishing Characters and general biology of Apterygota and Pterygota.</p> <p>1.3 Distinguishing Characters and general biology of endopterygota and exopterygota.</p> <p>1.4 Distinguishing Characters and general biology of coleoptera and diptera.</p> <p>1.5 Distinguishing Characters and general biology of orthoptera and hemiptera.</p>	7
<b>Unit II</b>	<p><b>Structure of Insects:</b></p> <p>2.1 Structure of insect body wall.</p> <p>2.2 Insect Head- structure and modification.</p> <p>2.3 Types of mouthparts and antennae.</p> <p>2.4 Thorax- Areas and sutures of tergum.</p> <p>2.5 Wings: structure and venation.</p> <p>2.6 Legs: structure and modifications</p>	8
<b>Unit III</b>	<p><b>Segmentation and Receptors:</b></p> <p>3.1 Abdomen- Segmentation and appendages.</p> <p>3.2 Genitalia and their modifications.</p> <p>3.3 Insect sense organs –mechanoreceptors.</p> <p>3.4 Photoreceptors.</p> <p>3.5 Chemoreceptors.</p>	7
<b>Unit IV</b>	<p><b>Digestive and Circulatory System of Insects:</b></p> <p>4.1 Structure of Digestive system of insects.</p> <p>4.2 Physiology of digestive system.</p> <p>4.3 Structure of Circulatory system of insects.</p> <p>4.4 Physiology of Circulatory system</p> <p>4.5 Modifications of Circulatory system.</p>	8
<b>Unit V</b>	<p><b>Respiratory and Excretory System of Insects:</b></p> <p>5.1 Structure of respiratory system of insects.</p> <p>5.2 Physiology of respiratory system.</p> <p>5.3 Structure of excretory system of insects.</p> <p>5.4 Physiology of excretory system.</p> <p>5.5 Modifications of excretory system.</p>	8



<b>Unit VI</b>	<b>Physiology of Metamorphosis:.</b> 6.1 Physiology of insect growth. 6.2 Physiology of metamorphosis in insects. 6.3 Polyphenism and diapause. 6.4 Biochemistry of insect cuticle 6.5 Physiology of moulting process.	7
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**Suggested Readings:**

1. Chapman RF. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge.
2. David BV & Ananthkrishnan TN. 2004. General and Applied Entomology.
3. Modern entomology by D.B. Tembhare
4. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
5. Evans JW. 2004. Outlines of Agricultural Entomology. Asiatic Publ., New Delhi.
6. Richards OW & Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman & Hall, London.
7. Saxena RC & Srivastava RC. 2007. Entomology: At a Glance. Agrotech Publ. Academy, Jodhpur.
8. Snodgrass RE. 1993. Principles of Insect Morphology. Cornell Univ. Press, Ithaca.
9. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
10. Kerkut GA & Gilbert LI. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. I-XIII. Pergamon Press, New York.
11. Patnaik BD. 2002. Physiology of Insects. Dominant, New Delhi.
12. Richards OW & Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Vol. 1. Structure, Physiology and Development. Chapman & Hall, New York.
13. Saxena RC & Srivastava RC. 2007. Entomology at a Glance. Agrotech Publ. Academy, Jodhpur.
14. Wigglesworth VB. 1984. Insect Physiology. 8th Ed. Chapman & Hall, New York.
15. Kerkut GA & Gilbert LI. 1985. Insect Physiology, Biochemistry and Pharmacology. Vols. I-XIII. Pergamon Press, Oxford, New York.
16. Muraleedharan K. 1997. Recent Advances in Insect Endocrinology. Assoc. for Advancement of Entomology, Trivandrum, Kerala.
17. CSIRO 1990. The Insects of Australia: A Text Book for Students and Researchers. 2nd Ed. Vols. I & II, CSIRO. Cornell Univ. Press, Ithaca.
18. Freeman S & Herron JC. 1998. Evolutionary Analysis. Prentice Hall, New Delhi.
19. Richards OW & Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman & Hall, London. 41 42

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<b>Course: Pr- Major Laboratory 6</b>		
<b>(DSC IIL3 Endocrinology + DSE III Entomology-1 Insect Classification, Morphology and Physiology)</b>		
<b>Subject Code: 3 ZOO 6</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100 (External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for Endocrinology**

1. Histological study of various vertebrate endocrine glands using permanent slides / photographs (Mammals, Crab and Insects).
2. Histology of various vertebrate endocrine glands (microtomy).
3. Morphological and histological study of various insect neuroendocrine structures.
4. Effect of toxicants on histoarchitecture of various endocrine glands.
5. Study of various endocrine disorders using photographs.
6. Study of effect of exogenous growth hormone on the growth of fish.
7. Study of vaginal smear during oestrous cycle of Rat.

**B) Practicals for Entomology-1 Insect Classification, Morphology and Physiology**

1. Identification and classification of insects from different orders (2 example from each order)
2. Mounting of different mouth parts of Mosquito, House fly, Cockroach.
3. Mounting of different antennae from Mosquito, Cockroach and other pest insects.
4. Haemolymph collection, staining and identification of haemocytes.
5. Slide preparation for different types of insect wings.
6. Study of different insect wing venation pattern.
7. To study the insect legs and their modifications
8. To study the types of insect larvae and pupae.
9. Study of Digestive system of insects by using chart/ PPT/ E-content.
10. Study of Circulatory system of insects by using chart/ PPT/ E-content.
11. Study of Excretory System of Insects by using chart/ PPT/ E-content.
12. Study of Respiratory system of insects by using chart/ PPT/ E-content.
13. Study of life cycle of House fly, Cockroach, Mosquito.

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) Endocrinology**

- |  |          |
|--|----------|
| 1. Histological Preparation/Experiment .....   | 12 Marks |
| 2. Identification, Labeling and Comment on<br>Spots / Photographs of endocrine disorders ..... | 08 Marks |

**Experiments from Section B) Entomology-1 Insect Classification, Morphology and Physiology**

- |   |          |
|---|----------|
| 3. Identification and classification of insects (06 spots)..... | 12 Marks |
| 4. Temporary slide preparation.....                             | 08 Marks |
| 6. Viva Voce .....  | 10 Marks |

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**TOTAL** **50 Marks**

**Internal Practical Marks**

- |   |            |
|---|------------|
| 1. Certified Practical Record                           | : 20 Marks |
| 2. Submission of Stained Permanent sides                | : 10 Marks |
| 3. Submission of photographic collection of insect pest | : 10 Marks |
| 4. Student Performance                                  | : 10 Marks |

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**TOTAL** **50 Marks**

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<b>Course: DSE III Fishery-I Th- Major Elective-I Fresh Water Fish Culture</b>		
<b>Subject Code: 3 ZOO 4</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3 Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

#### COs

1. Students will get acquaint with the various components of fish farm.
2. Students will get practical knowledge on feed formulation
3. Students will gain knowledge about different types of fish breeding techniques.
4. Students will gain knowledge about different types of fish pathogen and their treatments.

<b>Unit</b>	<b>Course Content</b>	<b>Hours</b>
<b>Unit I</b>	1.1 Riverine fisheries: Major river system in India. 1.2 Fishing methods, representative ichthyofauna, and recent catch statistics. 1.3 Problems encountered in fisheries development of major rivers. 1.4 Cold water fisheries: Cold water fisheries resources of India. 1.5 Representative species of fishes of cold water bodies of India.	<b>07</b>
<b>Unit II</b>	2.1 Reservoir and Lacustrine fisheries: Definition and ecological features of reservoirs and lakes. 2.2 Major reservoirs and lakes in India with emphasis on capture fisheries. 2.3 Development of reservoir fisheries in India. 2.4 Estuarine fisheries: Definition and classification of estuaries, capture fisheries resident and migrant species, fishing methods. 2.5 Fisheries of brackish water lake and backwaters.	<b>07</b>
<b>Unit III</b>	3.1 Scope and present status of aquaculture: Principles of site selection of various kinds of fish farms- quality and productivity of water, soil characteristics and other parameters. 3.2 Carp Culture: Pre -stocking, Stocking and Post stocking management of Nursery, Rearing and Stocking pond. 3.3 Criteria for selection of species for culture. 3.4 Different systems of aquaculture: Monoculture, Polyculture, Integrated fish farming, cage culture, pen culture. 3.5 Aquaculture diversification- Aquaponics system, Biofloc culture, IMTA and periphyton culture	<b>08</b>
<b>Unit IV</b>	4.1 Reproductive Biology of Fishes: Morphology and Histology of Pituitary, Testis and Ovary. 4.2 Hormonal regulation of spermatogenesis and oogenesis. 4.3 Role of GnRH and GTH on gonadal functions. 4.4 Natural breeding of fishes. Induced Breeding of Indian major carps and exotic carps by Hypophysation. 4.5 Hatchery Technology for Indian Major Carps. Glass jar hatchery, Chinese hatchery and other hatchery systems.	<b>08</b>
<b>Unit V</b>	5.1 Food and feeding habits of freshwater fishes, prawn, mussel and oysters. 5.2 Fundamental of Fish nutrition: Principles of fish nutrition and terminologies, 5.3 Role of nutrients and their requirement: amino acids, fatty acids, proteins, lipids, carbohydrates, vitamins and minerals for various growth stages of freshwater carp, prawn and mussel.	<b>08</b>

	5.4 Feed formulation: Conventional and non-conventional feed stuffs, feed formulation technology, growth promoting agents in aqua feed, single cell protein (SCP). 5.5 Presence of anti-nutritional factors and their removal procedures. Supplementary feed: Kind, Composition and nutrient source.	
<b>Unit VI</b>	6.1 Fish pathology and Management, Pathological processes: Cellular response to injury, inflammatory response to diseases, 6.2 Role of stress in fish disease, Parasitic and non-parasitic diseases: Protozoan diseases, fungal diseases, bacterial diseases, viral diseases. 6.3 Disease surveillance and reporting, Disease control through environmental management, Sanitary and phytosanitary agreement, 6.4 Vaccines used in aquaculture, Immuno-stimulants used in aquaculture, Bioremediation.	<b>07</b>

**Suggested Readings:**

1. AQC CMFRI Bulletin. 1987. National Seminar on Shellfish Resources and Farming.
2. Bardach EJ, Rhyther JH & Mc Larney WO. 1972. Aquaculture. The Farming and Husbandry of Freshwater and Marine Organisms .John Wiley & Sons.
3. Baton Rouge, De Silva SS & Anderson TA. 1995. Fish Nutrition in Aquaculture.
4. Chakraborty C & Sadhu AK. 2000. Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn. DayaPubl. House.
5. Diwan AD, Joseph S & Ayyappan S. 2008. Physiology of Reproduction, Breeding and Culture of Tiger Shrimp. Narendra Publ. House. Gilbert B. 1990. Aquaculture. Vol. II. Ellis Harwood
6. FAO Publ. ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.
7. FAO. 1992. Manual of Seed Production of Carps.
8. FAO. 2007. Manual for Operating a Small Scale Recirculation Freshwater Prawn Hatchery.
9. Fish Pathology. Author: Ronald J. Roberts. KP Biswas. Prevention and control of fish and prawn diseases.
10. Guillame J, Kaushik S, Bergot P & Metallier R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publ. Halver J & Hardy RW. 2002.
11. Halver JE & Tiews KT. 1979. Finfish Nutrition and Fishfeed Technology. Vols. I, II Heenemann, Berlin.
12. Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM, Philippines.
13. ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.
14. Jhingran VG & Pullin RSV. 1985. Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM, Philippines. Page 18 | 40
15. Jhingran VG. 1991. Fish and Fisheries of India. Hindustan Publ.
16. Khanna S.S. Introduction to Fishes. Silver Line
17. Landau M. 1992. Introduction to Aquaculture. John Wiley & Sons.
18. Mcvey JP. 1983. Handbook of Mariculture. CRC Press.
19. Ojha JS. 2005. Aquaculture Nutrition and Biochemistry. Daya Publ. ICAR 2006. Handbook of Fisheries and Aquaculture.
20. Pillay TVR & Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell.
21. Pillay TVR & Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell.
22. Piska Ravi Shankar, An Introduction to Aquaculture
23. Rath RK. 2000. Freshwater Aquaculture. Scientific Publ.
24. Srivastava C.B.L. & Sushma Srivastava. A Textbook of Fishery Science and Indian Fisheries. Kitab Mahal, Ashok Nagar, Allahabad, Fourth revised edition, 2016.
25. Thomas PC, Rath SC & Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.
26. Thomas PC, Rath SC & Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. DayaPubl.
27. Ujwala Jadhav (2010): Aquaculture Technology and Environment. Publ. PHI Publication

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<b>Course: Pr- Major Laboratory 6</b> <b>(DSC IIL3 Endocrinology + DSE III Fishery-I Fresh Water Fish Culture)</b>		
<b>Subject Code: 3 ZOO 6</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for Endocrinology**

1. Histological study of various vertebrate endocrine glands using permanent slides / Photographs (Mammals, Crab and Insects).
2. Histology of various vertebrate endocrine glands (Microtomy).
3. Morphological and histological study of various insect neuroendocrine structures.
4. Effect of toxicants on histoarchitecture of various endocrine glands.
5. Study of various endocrine disorders using photographs.
6. Study of effect of exogenous growth hormone on the growth of fish.
7. Study of vaginal smear during oestrous cycle of Rat.

**B) Practicals for Fishery-I Fresh Water Fish Culture**

1. Experiments on Water Analysis: Estimation Dissolved Oxygen, Free Carbon dioxide, Estimation of Dissolved Solids, Chlorides, Carbonate, Bicarbonate, Total Alkalinity, Total hardness, Estimation of Biological Oxygen Demand and Chemical Oxygen Demand.
2. Estimation of Primary productivity of any local pond, river, lake or reservoir.
3. Plankton Analysis: Collection, preservation and estimation of planktons, Quantitative analysis- Enumeration of Zooplanktons by i) drop count method ii) Sedgwick Rafter Cell method, Determination of population density, abundance and dominance of the species. Preparation of Diversity indices
4. Collection, identification and classification of locally available fishes
5. Collection and Identification of carp spawn and fry.
6. Collection and identification of common aquatic insects.
7. Collection and identification of common weeds.
8. Permanent micro preparation of different kinds of parasites in fishes.
9. Preparation of models and designing of cages and pens.
10. Visit to Fish farm. Submission of a detailed report on Fish Farm Visit)

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) Endocrinology**

1. Histological Preparation/Experiment ..... 12 Marks
2. Identification, Labeling and Comment on Spots / Photographs of endocrine disorders ..... 08 Marks

**Experiments from Section B) Entomology-1 Insect classification, morphology and physiology**

3. Major Experiments (Water/ Plankton Analysis)..... 12 Marks
4. Spotting (1 feed ingredient, 1 parasite, 1 aquatic insect, 1 aquatic weed).....08 Marks
5. Viva Voce ..... 10 Marks

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**TOTAL** **50 Marks**

**Internal Practical Marks**

1. Certified Practical Record : 20 Marks
2. Submission of Stained Permanent sides : 10 Marks
3. Submission of Fish farm Reports/ Model of cages/pens : 05 Marks
4. Micro-preparation of fish parasite : 05 Marks
5. Student Performance : 10 marks

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**TOTAL** **50 Marks**

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<b>Course: DSE III Animal Physiology-I Th- Major Elective</b>		
<b>Subject Code: 3 ZOO 4</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3 Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

**CO's: 3 ZOO 4**

- 1: Animal physiology gives the knowledge of biological processes through the investigation of physiological processes.
- 2: It enables to understand the chemical and molecular processes that occur in and between cells.
- 3: It also provides knowledge about the theoretical processes related to hormonal action.
- 4: Trains the students to perform laboratory exercises in Animal physiology that is applicable to Pathology laboratory, medicine, forensics and pharmaceutical industry.

<b>Units</b>	<b>Syllabus Content</b>	<b>Hours</b>
<b>Unit I</b>	<p><b>Physiology of Digestion:</b></p> <p>1.1 Digestion, Absorption, Utilization of Protein and Carbohydrates.</p> <p>1.2 Digestion, Absorption, Utilization of lipid.</p> <p>1.3 Histophysiology of gastric gland.</p> <p>1.4 Gastrointestinal Function—Peristalsis, Nervous Control</p> <p>1.5 Gastrointestinal peptides</p>	<b>8</b>
<b>Unit II</b>	<p><b>Physiology of Respiration:</b></p> <p>2.1 Physiology of Respiration: Anatomical and physiological organization of Respiratory system.</p> <p>2.2 Mechanism of respiration.</p> <p>2.3 Transport of gases by blood.</p> <p>2.4 Oxygen dissociation curve, CO<sub>2</sub> dissociation curve.</p> <p>2.5 Respiratory center and Neuro Hormonal and Chemical regulation of respiration.</p>	<b>7</b>
<b>Unit III</b>	<p><b>Physiology of Heart:</b></p> <p>3.1 Anatomy and histology of mammalian heart</p> <p>3.2 Structure &amp; function of Myogenic and neurogenic heart.</p> <p>3.3 Cardiac cycle, Cardiac sound.</p> <p>3.4 Pulmonary circulation.</p> <p>3.5 Cardiac arrest.</p>	<b>7</b>
<b>Unit IV</b>	<p><b>Physiology of Circulation:</b></p> <p>4.1 Composition of Blood.</p> <p>4.2 Regulation of heart beat and blood pressure.</p> <p>4.3 Origin and conduction of cardiac impulse.</p> <p>4.4. Myocardial infarction and cardiomyopathy.</p> <p>4.5. Hormonal control on circulation.</p>	<b>8</b>
<b>Unit V</b>	<p><b>Physiology of Excretion:</b></p> <p>5.1 Urine formation, Ultra filtration, Reabsorption, and Secretion.</p> <p>5.2 Significance of Henley's loop in production of hyper osmotic urine.</p> <p>5.3 Function of aldosterone, antidiuretic hormone.</p> <p>5.4 Rennin-Angiotensin system in renal physiology.</p> <p>5.5 Role of kidney in pH regulation and water salt regulation.</p>	<b>8</b>

<b>Unit VI</b>	<b>Lymphatic System:</b>	<b>7</b>
	6.1 Lymph-Composition and Formation	
	6.2 Functions of lymph.	
	6.3 Structure and functions of lymph nodes.	
	6.4 Lymphedema.	

**Suggested Reading:**

1. Baileys: Text book of Histology
2. Bell Davidson: Text book of physiology and Biochemistry
3. Bolander F.F.: Molecular endocrinology
4. Clerk E. E. C. Isolation and identification of Drugs in pharmaceutical of body fluid
5. Cole S. W.: The practical physiological chemistry.
6. Cooper: Poisoning by drugs and chemicals.
7. Eckert, Marsall: Animal physiology mechanism and Adaptations
8. Eckert & Ranadak: Animal physiology (CBS)2nd ED (1978)
9. Garden M.S.: Animal physiology principal and Adaptations.
10. Hara & Oserburg; An introduction to crimminalistie.
11. Hill R.W.: Comparative physiology of animals
12. Hoar W.S.: General and comparative physiology.
13. Houssa: Human physiology (McGraw Hill Books Company)
14. Hunter& Bornford: Hutchisons Clinical methods
15. Hynes: The Biology of polluted water.
16. Jacobs M. B.: The analytic toxicology of inorganic poison
17. Keil J.B., SamsonWrights a, : Applied Physiology
18. Heil E. Joets N.: Physiology (Oxford Uni press ) (1982)
19. Klein L: River pollution, causes& effects
20. Madhu Raj: Environmental Management of toxic and hazardous chemicals
21. Mill peter J.: Comparative neurobiology (Ed Hrbord London
22. Modi N.J.: Text Book of toxicology
23. Mitchell P.H.: Text Book of General physiology.
24. Norman A.W.: Hormones.
25. Odum: Fundamental of ecology.
26. Osterbong: The crime laboratory
27. Philips G.: Environmental physiology.
28. Prosser C.L.: Comparative animal physiology.
29. Ramkumar: Environmental Biodegradation.



<b>Course: Pr- Major Laboratory 6</b> <b>(DSC III.3 Endocrinology + DSE III Animal Physiology-I)</b>		
<b>Subject Code: 3 ZOO 6</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for Endocrinology**

1. Histological study of various vertebrate endocrine glands using permanent slides / Photographs (Mammals, Crab and Insects).
2. Histology of various vertebrate endocrine glands (Microtomy).
3. Morphological and histological study of various insect neuroendocrine structures.
4. Effect of toxicants on histoarchitecture of various endocrine glands.
5. Study of various endocrine disorders using photographs.
6. Study of effect of exogenous growth hormone on the growth of fish.
7. Study of vaginal smear during oestrous cycle of Rat.

**B) Practicals for Animal Physiology-I**

1. Simple muscle curve Effects of temperature and calcium.
2. Estimation of serum creatinine.
3. Estimation of serum urea.
4. Qualitative analysis of urea
5. Quantities estimation of calcium, phosphorus sodium and potassium.
6. Separation and identification of amino acids by paper and thin layer chromatography-
7. Separation of proteins by paper or SDS-PAGE electrophoresis.
8. Determination of Erythrocyte sedimentation rate (E.S.R.)
9. Determination of pack cell volume (P.C.V).
10. Determination of mean corpuscular volume (M.V.C.)
11. Detection of blood by haemin crystals test.
12. Estimation of protein in blood.
13. Estimation of glucose in given sample.
14. Estimation of cholesterol in blood.

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) Endocrinology**

- |   |          |
|---|----------|
| 1. Histological Preparation/Experiment .....  | 12 Marks |
| 2. Identification, Labeling and Comment on Spots / Photographs of endocrine disorders ..... | 08 Marks |

**Experiments from Section B) Entomology-1 Insect classification, morphology and physiology**

- |                                      |          |
|--------------------------------------|----------|
| 3. Major physiology experiments..... | 12 Marks |
| 4. Minor physiology experiments..... | 08 Marks |
| 5. Viva Voce .....                   | 10 Marks |

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<b>TOTAL</b>	<b>50 Marks</b>
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**Internal Practical Marks**

- |  |            |
|--|------------|
| 1. Certified Practical Record                        | : 20 marks |
| 2. Submission of Stained Permanent sides             | : 10 marks |
| 3. Survey and collection of Data of Blood Parameters | : 10 marks |
| 4. Student Performance                               | : 10 marks |

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<b>TOTAL</b>	<b>50 Marks</b>
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Course: DSE III Molecular Biology-1 Th- Major Elective-I		
Subject Code: 3 ZOO 4	No. of Credits: 3	No. of hours per week: 3
Exam duration: 3 Hrs	Maximum Marks: 100 (External:60 Internal:40)	Total No. of contact hours: 45

**CO's: 3 ZOO 4**

- 1: Molecular Biology gives the knowledge of biological processes through the investigation of molecular mechanisms.
- 2: It enables to understand the chemical and molecular processes that occur in and between cells.
- 3: Trains the students to perform laboratory exercises in Molecular Biology that is applicable to medicine, forensics and pharmaceutical industry.

Unit	Contents	Hours
<b>Unit-I</b>	<p><b>DNA replication:</b></p> <p>1.1 Enzymes of DNA replication.</p> <p>1.2 Mechanism of prokaryotic DNA replication.</p> <p>1.3 Mechanism of eukaryotic DNA replication.</p> <p>1.4 Replication of telomeres.</p> <p>1.5 Assembly of newly replicated DNA into nucleosomes.</p>	<b>07</b>
<b>Unit-II</b>	<p><b>Transcription and its Regulation:</b></p> <p>2.1 Regulatory elements.</p> <p>2.2 Mechanism of prokaryotic and eukaryotic transcription.</p> <p>2.3 Transcription regulation in eukaryotes.</p> <p>2.4 Transcriptional and post-transcriptional gene silencing.</p> <p>2.5 Transcription regulation in prokaryotes: Lac and Trp operon.</p>	<b>08</b>
<b>Unit-III</b>	<p>3.1 Co -and Post-transcriptional modifications in mRNA, Nuclear export of mRNA, mRNA stability.</p> <p><b>Translation (Protein synthesis):</b></p> <p>3.2 Genetic code.</p> <p>3.3 Protein synthesis in prokaryotes and eukaryotes.</p> <p>3.4 Regulation of translation.</p> <p>3.5 Co- and post-traslational modifications of proteins.</p>	<b>08</b>
<b>Unit-IV</b>	<p><b>DNA Markers:</b></p> <p>4.1 Restriction fragment length polymorphism (RFLP).</p> <p>4.2 Random amplified polymorphic DNA (RAPD).</p> <p>4.3 Amplified fragment length polymorphism (AFLP).</p> <p>4.4 Single-nucleotide polymorphism (SNP).</p> <p>4.5 <b>Hybridization Techniques:</b> Preparation of radioactive and nonradioactive probes, Southern blotting, Northern blotting, Western blotting, Fluorescence in situ hybridization (FISH).</p>	<b>07</b>
<b>Unit-V</b>	<p><b>Recombinant DNA Technology (RDT):</b></p> <p>5.1 Enzymes used in RDT.</p> <p>5.2 Vectors used in RDT: Plasmids, Bacteriophages, Phagemids, Cosmids, BACs, PACs, YACs.</p> <p>5.3 Procedure of RDT.</p> <p>5.4 Applications of RDT.</p> <p>5.5 Construction and screening of genomic and cDNA library.</p>	<b>07</b>



<b>Unit-VI</b>	<p><b>Sequencing and Other Techniques:</b></p> <p>6.1 <b>DNA Sequencing Techniques:</b> Sanger's dideoxy method, Illumina sequencing, Ion torrent sequencing, Nanopore sequencing, and Single-molecule real-time (SMRT) sequencing.</p> <p>6.2 Protein sequencing by Sanger's method.</p> <p>6.3 <b>DNA Fingerprinting:</b> Principle, procedure and applications.</p> <p>6.4 <b>Polymerase Chain Reaction:</b> Methodology, modifications, applications, advantages and limitations.</p> <p>6.5 <b>RNA Interference (RNAi):</b> MicroRNA and SiRNAs.</p>	<b>08</b>
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**Suggested Reading:**

1. Allison Lizabeth. **Fundamental Molecular Biology**. Blackwell Publishing.
2. Brown, T. A. **Genomes 4**. Garland Science.
3. Clark David, Pazdernik N. J., and M. R. McGehee. **Molecular Biology**, 3/Ed. Academic Press.
4. Cox Michael *et al.* **Molecular Biology-Principles and Practice**. W. H. Freeman and Company.
5. Glick Bernard *et al.* **Molecular Biotechnology**, 4/Ed. ASM Press, Washington DC.
6. Glick Bernard. **Medical Biotechnology**. ASM Press, Washington DC.
7. Karp Gerald. **Cell and Molecular Biology**, 8/Ed. John Wiley and Sons, Inc.
8. Krebs Jocelyn E. **Lewin's Genes XII**. Jones & Batlett Learning.
9. Lodish H. *et al.* **Molecular Cell Biology**, 9/Ed. W. H. Freeman and Company.
10. Reece Richard J. **Analysis of Genes and Genomes**. John Wiley & Sons, Ltd.
11. Schleif Robert. **Genetics and Molecular Biology**, 2/Ed. The Johns Hopkins University Press.
12. Walker John and R. Raply (Editors). **Molecular Biology and Biotechnology**, 5/Ed. RSC Publishing.
13. Wink M. (Editor). **An Introduction to Molecular Biotechnology**. Wiley-VCH Verlag GmbH and Co.



<b>Course: Pr- Major Laboratory 6</b> <b>(DSC III.3 Endocrinology + DSE III Molecular Biology-1)</b>		
<b>Subject Code: 3 ZOO 6</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for Endocrinology**

1. Histological study of various vertebrate endocrine glands using permanent slides / photographs (Mammals, Crab and Insects).
2. Histological preparation of various vertebrate endocrine glands (microtomy).
3. Morphological and histological study of various insect neuroendocrine structures.
4. Effect of toxicants on histoarchitecture of various endocrine glands.
5. Study of various endocrine disorders using photographs.
6. Study of effect of exogenous growth hormone on the growth of fish.
7. Study of vaginal smear during oestrous cycle of Rat.

**B) Practicals for Molecular Biology-1**

1. DNA fingerprinting.
2. Extraction of DNA from bacteria.
3. Extraction of DNA from yeast.
4. Extraction of DNA from animal tissue.
5. Extraction of DNA from whole blood.
6. Determination of molecular size of DNA.
7. Restriction digestion.
8. Preparation and demonstration of plasmid by gel electrophoresis.
9. Isolation and cleaning of DNA fragment of interest from the agarose gel.
10. Electrophoretic separation and determination of molecular weight of protein by SDS-PAGE.

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) Endocrinology**

- |   |          |
|---|----------|
| 1. Histological Preparation/Experiment .....  | 12 Marks |
| 2. Identification, Labeling and Comment on Spots / Photographs of endocrine disorders ..... | 08 Marks |

**Experiments from Section B) Molecular Biology-1**

- |  |          |
|--|----------|
| 3. DNA electrophoresis based experiment..... | 12 Marks |
| 4. DNA extraction based experiment .....     | 08 Marks |
| 5. Viva Voce .....                           | 10 Marks |

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<b>TOTAL</b>	<b>50 Marks</b>
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**Internal Practical Marks**

- |   |            |
|---|------------|
| 1. Certified Practical Record               | : 20 marks |
| 2. Submission of Stained Permanent sides    | : 10 marks |
| 3. Submission of Photographs of Stained Gel | : 10 marks |
| 4. Student Performance                      | : 10 marks |

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<b>TOTAL</b>	<b>50 Marks</b>
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**M. Sc. Zoology (NEPv23) Semester-IV**

<b>Course: DSC I.4 Biochemistry Th- Major</b>		
<b>Subject Code: 4 ZOO 1</b>	<b>No. of Credits: 4</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 3 Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 60</b>

**CO's: 4 ZOO 1**

- 1: Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms.
- 2: Understanding of concepts of acids, bases, indicators, pKa values, etc. Acquiring skill to determine pKa value of amino acids.
- 3: physical and chemical properties of molecules as a linkage of biochemistry.
- 4: Illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways.
- 5: It trains the students to carry out laboratory exercises in biochemistry and biochemical investigations.

<b>Units</b>	<b>Syllabus Content</b>	<b>Hours</b>
<b>Unit I</b>	<p><b>Chemical Foundations of Biochemistry:</b></p> <p>1.1 pH, pK, acids, bases, buffers, free energy and isomerization.</p> <p>1.2 Entropy, enthalpy and free energy.</p> <p>1.3 Physical properties of water.</p> <p>1.4 <b>Bonds and forces stabilizing biomolecules:</b> Covalent bond, Van-der-Waals Electrostatics, hydrogen bonding and hydrophobic interactions.</p> <p>1.5 Biologically important monosaccharides, disaccharides and polysaccharides.</p>	<b>10</b>
<b>Unit II</b>	<p><b>Amino acids and Proteins:</b></p> <p>2.1 Classification and structure of standard amino acids.</p> <p>2.2 Transamination and deamination.</p> <p>2.3 Protein structure &amp; folding, Ramachandran plot.</p> <p>2.4 Conjugated proteins: structure and function.</p>	<b>10</b>
<b>Unit III</b>	<p><b>Nucleic Acids:</b></p> <p>3.1 Structure of DNA</p> <p>3.2 Structural polymorphism of DNA (A, B and Z-DNA).</p> <p>3.3 Triplex and quadruplex DNA.</p> <p>3.4 Structure and functions of mRNA, rRNA and tRNA.</p> <p>3.5 Circular DNA.</p>	<b>10</b>
<b>Unit IV</b>	<p><b>Amino Acid and Nucleotide Metabolism:</b></p> <p>4.1 Ornithine cycle.</p> <p>4.2 Biosynthesis of nutritionally non-essential amino acids.</p> <p>4.3 <i>De novo</i> and salvage pathways of nucleotide biosynthesis.</p> <p>4.4 Degradation of nucleotides.</p>	<b>10</b>
<b>Unit V</b>	<p><b>Carbohydrate metabolism:</b></p> <p>5.1 Glycolysis, its regulation and energetics.</p> <p>5.2 TCA cycle &amp; its regulation.</p> <p>5.3 Gluconeogenesis and its regulation.</p> <p>5.4 Glycogenesis, Glycogenolysis, coordinated regulation.</p> <p>5.5 Pentose phosphate pathway.</p> <p>5.6 Electron transport complexes, electron transport, oxidative phosphorylation, Energetics of electron transfer.</p>	<b>10</b>

<b>Unit VI</b>	<p><b>Lipid Metabolism:</b></p> <p>6.1 Biosynthesis of fatty acids, triglycerides, phospholipids and cholesterol.</p> <p>6.2 <math>\beta</math>-oxidation of saturated, monounsaturated and polyunsaturated fatty acids.</p> <p>6.3 <math>\alpha</math> - and <math>\omega</math>-oxidation of fatty acids.</p> <p>6.4 Coordinated regulation of fatty acid synthesis and breakdown.</p> <p>6.5 Obesity and the regulation of body mass.</p> <p>6.6 Biosynthesis of ketone bodies.</p>	<b>10</b>
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**Suggested Reading :**

1. Appling Dean R. *et al.* **Biochemistry**-Concepts and Applications, Pearson.
2. Baynes, John W Baynes *et al.* **Medical Biochemistry**, 4/Ed. Elsevier Saunders.
3. Berg, Jeremy M. *et al.* **Biochemistry**, 8/Ed. W. H. Freeman and Company.
4. Campbell, Mary K. *et al.* **Biochemistry**, 8/Ed. Cengage Learning.
5. Chatterjea, M. N. *et al.* **Textbook of Medical Biochemistry**, 8/Ed. Jaypee Brothers Medical
6. Devlin, T. M. (Editor). **Textbook of Biochemistry**, 7/Ed. John Wiley & Sons, Inc.
7. Garrett, Reginald H. **Biochemistry**, 6/Ed. Cengage Learning.
8. Mathews, Christopher K. **Biochemistry**, 4/Ed. Pearson.
9. Moran, Laurence A. *et al.* **Principles of Biochemistry**, 5/Ed. Pearson.
10. Nelson, D. L. *et al.* **Lehninger Principles of Biochemistry**, 8/Ed. Macmillan Learning.
11. Pelley John W. **Biochemistry**, 2/Ed. Elsevier Saunders.
12. Pratt, Charlotte W. **Essential Biochemistry**, 4/Ed. John Wiley and Sons, Inc.
13. Puri Dinesh. **Textbook of Medical Biochemistry**, 3/Ed. Elsevier.
14. Rodwell, Victor W. **Harper's Illustrated Biochemistry**, 31/Ed. McGraw Hill Education.
15. Satyanarayana, U. **Biochemistry**. Books and Allied (P) Ltd.
16. Vasudevan, D. M. *et al.* **Textbook of Biochemistry**, 6/Ed. Jaypee Brothers Medical Publishers.
17. Voet, D. *et al.* **Biochemistry**, 4/Ed. John Wiley and Sons, Inc.
18. Voet, D. *et al.* **Fundamentals of Biochemistry**, 5/Ed. John Wiley and Sons, Inc.
19. Zubay Geoffrey L. *et al.* **Principles of Biochemistr**. Wm. C. Brown Publishers.

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Course: DSC II.4 Enzymology and Biostatistics Th- Major		
Subject Code: 4 ZOO 2	No. of Credits: 4	No. of hours per week: 4
Exam duration: 3 Hrs	Maximum Marks: 100 (External:60 Internal:40)	Total No. of contact hours: 60

**COs: 4 ZOO 2**

1. Enzymology enables to understand the role and activities of various enzymes functioning in the body.
2. It also gives some idea about clinical and pharmaceutical applications of enzymes.
3. It trains the students to carry out laboratory exercises related to enzyme activity and estimations of enzymes.
4. Biostatistics trains the students in handling and analyzing the biological clinical data.

Unit	Contents	Hours
<b>Unit-I</b>	<p><b>Enzymes-Structure, Classification and Kinetics:</b></p> <p>1.1 Introduction and classification of enzymes.            1.2 RNA World Hypothesis            1.3 Features of enzyme's active site.            1.4 Mechanism of enzyme action (Chymotrypsin).            1.5 Kinetics of single substrate and bisubstrate enzyme catalyzed reactions.            1.6 Effect of pH and temperature on enzymes</p>	<b>10</b>
<b>Unit-II</b>	<p><b>Enzymes-Categories &amp; Regulation:</b></p> <p>2.1 Enzyme Activators and Inhibitors.            2.2 Isozymes, ribozymes and abzymes.            2.3 Allosteric enzymes.            2.4 Cooperativity in enzyme catalysis.            2.5 Zymogen activation.            2.6 Covalent modification.</p>	<b>10</b>
<b>Unit-III</b>	<p><b>Enzymes-Functional Diversity:</b></p> <p>3.1 Mechanism of coenzyme action (NAD, FAD, TPP, Pyridoxal phosphate, biotin)            3.2 Enzymes involved in free radical removal.            3.3 Enzymes involved in cell signaling.            3.4 Enzymes involved in nucleic acid metabolism (DNA replication, DNA repair and transcription).            3.5 Enzymes involved in energy production (Glycolysis and TCA cycle).</p>	<b>10</b>
<b>Unit-IV</b>	<p><b>Enzyme Applications:</b></p> <p>4.1 Applications of Immobilized enzymes.            4.2 Industrial uses of enzymes: Use of lactase in dairy industry            4.3 Use of proteases in food, leather and detergent industry            4.4 Enzymes and modern medicine.            4.5 Use of enzymes in fermentation process,            4.6 Enzyme Engineering and site directed mutagenesis</p>	<b>10</b>
<b>Unit- V</b>	<p><b>Biostatistics:</b></p> <p>5.1 Diagrammatic representation of data (Line graph, Histogram, Bar diagram, Pie diagram).            5.2 Graphic representation of data (frequency polygon, frequency curve, cumulative Frequency).            5.3 Measurement of central tendency (Mean, median, mode)</p>	<b>10</b>

	5.4 Standard deviation. 5.5 Standard error. 5.6 Significance test (Students't' - test) - paired and unpaired.	
<b>Unit-VI</b>	<b>Biostatistics:</b> 6.1 Chi square test as a test for goodness of fit. 6.2 Analysis of variance (ANOVA). 6.3 Correlation analysis: Correlation types and methods to study correlation, Significance test of correlation coefficient. 6.4 Regression analysis: Kinds of regression analysis (regression line, Regression Equations). 6.5 Applications of Biostatistics in research.	<b>10</b>

**Suggested Readings:**

1. Animal Cell Culture – A practical approach, Ed. JohnR.W. Masters. IRL Press.
2. Introduction to instrumental analysis, Robert Braun. McGraw Hill International Editions.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. K. Wilson & K.H. Goulding, ELBS Edn.
4. Samuel Delvin, Enzymes, Sarup & Sons, N. Delhi
5. Practical biochemistry edited by Walker
6. Foundation in microbiology: Talaro
7. Microbiology: Pelczar
8. Biology of microorganisms: Madigan, Martinko and Parker.
9. Biophysical chemistry- Principles and technique: Upadhyay, Nath
10. Statistical techniques in Bioassay Z. Govidarajulu (2000): Pub.S.Kargar
11. Statistical method in Bioassay Pub D.J. Finney (1971): Griffin
12. Laboratory manual for Biochemistry and Molecular biology, Shivnery Publishers R. N. Vankhede & S. N. Niwane
13. Probit analysis D.J. Finney (1971): 3rd edition Pub. Griffin

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<b>Course: Pr- Major Laboratory 7</b> <b>(DSC I.4- Biochemistry + DSC II.4 - Enzymology and Biostatistics )</b>		
<b>Subject Code: 3 ZOO 7</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

#### **A) Practicals for Biochemistry**

1. Determination of isoelectric pH of amino acids.
2. Estimation of amino acids by Ninhydrin method.
3. Estimation of serum protein.
4. Estimation of plasma /serum glucose.
5. Estimation of glycogen from tissue.
6. Determination of acid value of fat.
7. Estimation of serum cholesterol.
8. Estimation of phospholipids.
9. Estimation of plasma calcium.
10. Estimation of Protein by Biuret method (Qualitative Test).
11. Isolation of casein from milk.

#### **B) Practicals for Enzymology and Biostatistics**

1. Study effect of pH and temperature on enzyme activity. Ex. Salivary amylase.
2. To study the effect of inhibitors on enzyme activity.
3. Colorimetric estimation of some respiratory enzymes.
4. Estimation of plasma / serum glucose.
5. Estimation of glycogen from tissue.
6. Estimation of serum cholesterol.
7. Estimation of phospholipids.
8. Estimation of lactate dehydrogenase.
9. Estimation of plasma proteins.
10. Estimation of Na ions.
11. Estimation of K ions.
12. Estimation of Calcium.
13. Estimation of ATPase.
14. Estimation of SGOT / SGPT.
15. Estimation of Acetylcholinesterase.
16. Estimation of acid alkaline phosphatase.
17. Estimation of catalase.
18. Examples from Biostatistics as per theory.
19. Drawing Pie, Bar (column) and Line diagrams on computer.

Note: Besides these any other additional experiment relevant to the syllabus.

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) Biochemistry**

- 1. Major Estimation/Experiment..... 12 Marks
- 2. Minor Estimation/Experiment ..... 08 Marks

**Experiments from Section B) Enzymology and Biostatistics**

- 3. Major Estimation/Experiment .....12 Marks
- 4. Minor Estimation/Experiment ..... .08 Marks
- 5. Viva Voce ..... 10 Marks

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**TOTAL** **50 Marks**

**Internal Practical Marks**

- 1. Certified Practical Record : 20 Marks
- 2. Submission of elaborative report  
    on five biochemical disorders : 10 Marks
- 3. Submission of Pie, Bar and Line diagrams on computer : 10 Marks
- 4. Student Performance : 10 Marks

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**TOTAL** **50 Marks**

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<b>Course: DSC III.4 General Parasitology Th- Major</b>		
<b>Subject Code: 4 ZOO 3</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

**CO's: 4 ZOO 3**

1. Learn the various types of parasites and hosts.
2. Establish the relationship between a parasite and the host and their effects.
3. Students can differentiate the parasitic Protozoan, Helminthes, and Nematodes.
4. Learn of the geographic distribution, life cycle, pathogenicity control and treatment of Protozoan, Helminthes, Nematode parasites.
5. Learn the different vectors of Arthropods.

Unit	Contents	Hours
<b>Unit-I</b>	<p><b>Concept of Parasitology</b></p> <p>1.1 Basic concept of Parasitism.</p> <p>1.2 Symbiosis, phoresis, commensalisms, mutualism, parasitoids.</p> <p>1.3 Types of Parasites and hosts.</p> <p>1.4 Parasitic transmission.</p> <p>1.5 Parasitic adaptations.</p> <p>1.6 Advantages and disadvantages in parasitic life.</p>	<b>7</b>
<b>Unit-II</b>	<p><b>Protozoan Parasitology:</b></p> <p>2.1 Characteristics of protozoa parasites. Protozoan parasitic diseases (<i>Giardiasis, toxoplasmosis, amoebiasis, African trypanosomiasis</i>)</p> <p>2.2 Parasitic protozoa and interaction with host.</p> <p>2.3 Life cycle and diseases caused by Plasmodium sp.</p> <p>2.4 Vectors of protozoan parasites.</p> <p>2.5 Control strategies.</p>	<b>8</b>
<b>Unit-III</b>	<p><b>Helminth Parasitology:</b></p> <p>3.1 General characters of Phylum: Platyhelminthes, Nematelminthes and Acanthocephala</p> <p>3.2 Classification of helminth parasites.</p> <p>3.3 life cycle, transmission, pathogenesis, symptoms, epidemiology, diagnosis and General control measures of liver fluke <i>Fasciola</i> spp.</p> <p>3.4 life cycle, transmission, pathogenesis, symptoms, epidemiology, diagnosis and General control measures of blood flukes <i>Schistosoma nasale</i> spp.</p> <p>3.5 Larval form of Helminthes.</p>	<b>7</b>
<b>Unit-IV</b>	<p><b>Nematode parasitology:</b></p> <p>4.1 Classification, general account of nematodes.</p> <p>4.2 Mode of transmission and pathogenicity</p> <p>4.3 <b>Morphology, Life-cycle, Treatment and Prophylaxis of-Wuchereria Sp,</b></p> <p>4.4 <i>Ancylostoma</i> Sp</p> <p>4.5 <i>Dracunculus</i> Sp</p>	<b>8</b>
<b>Unit- V</b>	<p><b>Parasitic Zoonoses:</b></p> <p>5.1 Introduction of Zoonosis.</p> <p>5.2 Nature and epidemiology of zoonotic viral diseases (Rabies, dengue, Japanese encephalitis).</p>	<b>8</b>

	5.3 Bacterial diseases (Brucellosis, Plague). 5.4 Protozoan diseases (Toxoplasmosis, Trypanosomiasis, Leishmaniasis and Babesiosis). 5.5 Prevention and control of parasitic zoonoses.	
<b>Unit-VI</b>	<b>Vector Biology:</b> 6.1 Vectors and its importance in transmission of parasites. 6.2 Vector and transmission of diseases- mosquito, tick, lice, fleas. 6.3 Host-vector relationship. 6.4 Mechanical and biological vector. 6.5 Vector control and prevention of vector borne disease transmission.	<b>7</b>

**Suggested Readings:**

1. Arora D.R. and Arora B. (2005). Medical Parasitology. CBS Publishers and Distributors, New Delhi. Arora D.R.(2004). Textbook of Microbiology. CBS Publishers & Distributors, New Delhi.
2. Arthur D.R. (1962). Ticks and Disease. Harper and Row, New York.
3. Belding D. L. Meredith .(1956). Textbook of Parasitology. New York
4. Chandler A.C. and Read C.P. (1961). Introduction to Parasitology. John, Wiley and Sons, Inc.
5. Chatterji K.D. Parasitology (Protozoology & Helminthology). Medical Publishers, Calcutta, India
6. Cheng T.C.W.B. (1964). The Biology of Animal Parasites. Saunders Co. Philadelphia and London.
7. Craig and Faust . (1945). Clinical Parasitology. The Macmillan Co., Philadelphia.
8. Dawes B. (1968). The Trematoda. Cambridge University Press. Revised.
9. Dawes B.(1947). The Trematoda of British Fishes. Ray Society, London.
10. Dey N.C., Messrs. (1964). Medical Parasitology, Allied Agency, Calcutta.
11. Dhaar G.M. and Robbani I.(2006). Foundations of Community Medicine. Published by Elsevier, a division of Reed Elsevier India Private Ltd., New Delhi.
12. Dubey R.C. and Maheshwari D.K.(1999). A text book of Microbiology. S. Chanda & Company Ltd., New Delhi.
13. Parija S.C. Review of Parasitic Zoonoses. A.I.T.B.S.Publishers and Distributors, Delhi.
14. Park K. (2003). Text book of Preventive and Social Medicine. Banarsidas Bhanot Publishers Jabalpur, India.
15. Poinar G.O. Jr.(1979). Nematodes for Biological Control of Insects. CRC Press Florida.
16. Subash C. (1996). Text Book of Medical Parasitology. Pariya and All India Publishers & Distributions, Madras.



<b>Course: DSE IV Entomology-II Th-Major Elective II</b>		
<b>Industrial Entomology and Insect Pest Management</b>		
<b>Subject Code: 4 ZOO 4</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

**CO's: 4 ZOO 4**

- 1: Students are trained in life history and ecology of insect pests and predators/ parasites as well as the basic principles and strategies of their management.
- 2: The knowledge acquired and skill developed in the field of entomology
- 3: Understand the role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action.
- 4: Acquire an understanding about chemical insecticides.
5. Develop skill related with sericulture, apiculture and lac culture.

<b>Units</b>	<b>Syllabus Content</b>	<b>Hours</b>
<b>Unit I</b>	<b>Mulberry sericulture:</b> 1.1 Cultivation of food plants. 1.2 Rearing of silkworms. 1.3 Harvesting and processing of cocoons 1.4 Diseases of <i>Bombyx mori</i> . 1.5 Predators and parasitoids of silkworm and their management.	<b>7</b>
<b>Unit II</b>	<b>Apiculture:</b> 2.1 Organization of bee colony. 2.2 Dance language of honeybees. 2.3 Diseases of honeybees. 2.4 Beekeeping methods: Equipment and tools 2.5 Apiary management.	<b>8</b>
<b>Unit III</b>	<b>Lac culture:</b> 3.1 Lac insect and its life history. 3.2 Host plant management. 3.3 Strains of lac insects, Propagation of lac insects. 3.4 Lac crop management. 3.5 Natural enemies of lac insects and their management. 3.6 Lac extraction and lac products.	<b>7</b>
<b>Unit IV</b>	<b>Nature and extent of damage, seasonal abundance of followings:</b> 4.1 Insect pests of cereals and millets. 4.2 Insect pests of pulses, tobacco, oilseeds. 4.3 Insect pests of fiber crops, forages, sugarcane. 4.4 Insect pests of Fruit Crops- mango, guava, banana citrus. 4.5 Major Insect pests of tomato, Brinjal, okra. 4.6 Major Insect pests of stored grain.	<b>8</b>
<b>Unit V</b>	<b>Biological control of pest:</b> 5.1 important groups of Parasitoids, predators and pathogens for pest control. 5.2 Augmentation and conservation. 5.3 Host seeking behavior of predatory and parasitic groups of insects. 5.4 Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc 5.5 Biological control of weeds using insects.	<b>7</b>

<b>Unit VI</b>	<b>Chemical control of Insect pest:</b>	<b>8</b>
	6.1 Pesticide use and pesticide industry in India.	
	6.2 Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature.	
	6.3 Structure and mode of action of organochlorines, organophosphates, Carbamates, pyrethroids.	
	6.4 Action of insecticides- synergism, potentiation and antagonism	
	6.5 Pest resistance to insecticides; mechanisms and types of resistance	
	6.6 Insecticide resistance management and pest resurgence.	

**Suggested Readings :**

1. Atwal AS. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.
2. Ganga G. 2003. Comprehensive Sericulture. Vol. II. Silkworm Rearing and Silk Reeling. Oxford & IBH, New Delhi.
3. Partiban S & David BV. 2007. Management of Household Pests and Public Health Pests. Namratha Publ., Chennai.
4. Singh S. 1975. Beekeeping in India. ICAR, New Delhi.
5. Aruga H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi.
6. Dhaliwal GS & Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publ., New Delhi.
7. Dhaliwal GS, Singh R & Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani
8. Flint MC & Bosch RV. 1981. Introduction to Integrated Pest Management. 1st Ed., Springer, New York.
9. Partiban S & David BV. 2007. Management of Household Pests and Public Health Pests. Namratha Publ., Chennai.
10. Atwal AS, Dhaliwal GS & David BV. 2001. Elements of Economic Entomology. Popular Book Depot, Chennai.
11. Dunston AP. 2007. The Insects: Beneficial and Harmful Aspects. Kalyani Publ., New Delhi
12. Evans JW. 2005. Insect Pests and their Control. Asiatic Publ., New Delhi.
13. Nair MRGK. 1986. Insect and Mites of Crops in India. ICAR, New Delhi.
14. Prakash I & Mathur RP. 1987. Management of Rodent Pests. ICAR, New Delhi.
15. Saxena RC & Srivastava RC. 2007. Entomology at a Glance. Agrotech Publ. Academy, Jodhpur.

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<b>Course: Pr- Major Laboratory 8</b> <b>(DSC I.4- General Parasitology + DSE IV Entomology-II- Industrial Entomology and Insect Pest Management )</b>		
<b>Subject Code: 3 ZOO 8</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for General Parasitology**

1. Slides / museum specimens of selected parasites of representative groups of protozoans and Helminths (Plasmodium, Trypanosoma, Leishmania, Ascaris (male & female), Hookworm, Ancylostoma sp., Wucheria sp..
2. Study of life cycles and morphology of Vectors: Anopheles, Culex and, Aedes species (Adults, eggs, larvae and pupae), house fly, cockroach, bed bug.
3. Ticks and mites: Argus, Sarcoptes, Psoroptes , Hemaphysalis spinigera
4. Collection of ticks and mites from domestic animals.
5. Histological preparation of parasites in tissues.
6. Preparation of blood smear for protozoan / nematode parasites.

**B) Practicals for Entomology-II- Industrial Entomology and Insect Pest Management**

1. Identification of immature insects to orders and families, in endopterygote orders viz., Diptera, Lepidoptera, Hymenoptera and Coleoptera using key.
  2. Identification of honey bee species, bee castes and special adaptations.
  3. Visit to bee nursery and commercial apiaries.
  4. Visit to Silkworm rearing and management center.
  5. Field collection of parasitoids and predators.
  6. Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers.
  7. Control of silverfishes in the library
  8. Study of life history of important insect pests and non-insect pest.
  9. Lac host and crop management technology and processing of lac.
- Note: Besides these any other additional experiment relevant to the syllabi depending on resource.

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) General Parasitology**

1. Identification of spots. .... 12 Marks
2. Study of life cycle/morphological identification of vectors..... 08 Marks

**Experiments from Section B) Entomology-II- Industrial Entomology and Insect Pest Management**

3. Identification and classification of insects Pest (photograph/slides) (04 spots)..... 08 Marks
4. life history of any insect pest.....08 Marks
5. Submission of field visit report.....04 Marks
6. Viva Voce ..... 10 Marks

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**TOTAL** **50 Marks**

**Internal Practical Marks**

1. Certified Practical Record : 20 marks
2. Submission of collection of ticks and mites : 10 marks
3. Submission of case study of successfully Biological control project : 10 marks
4. Student Performance : 10 marks

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**TOTAL** **50 Marks**

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<b>Course: DSE IV Fisheries II Major Elective</b>		
<b>Fish Harvesting, Marketing and Aquarium Management</b>		
<b>Subject Code: 4 ZOO 4</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

**COs**

1. Students will get familiar with the various fishing methods.
2. Students will gain knowledge about fish spoilage and causative agents.
3. Students will know about different seafood packaging materials and methods of packaging and transport.
4. Students will acquire knowledge on quality assurance in fish processing
5. Students will acquire a skill of aquarium fabrication and maintenance.

<b>Unit</b>	<b>Course Content</b>	<b>Hours</b>
<b>Unit I</b>	1.1 Traditional methods of fish harvesting: Traps, Ring seine, Trammel net, Mini trawls, Gill nets, Hook and line, traps and pots. 1.2 Modern methods of fish harvesting: Trawling, Purse seining, Gill net, Hook and line mechanized. 1.3 Unconventional fishing methods: Electrofishing, light fishing, Echo sounder and sonar. 1.4 Biological factors in fishing. 1.5 Fishing crafts- Mechanized and non-mechanized boats.	<b>07</b>
<b>Unit II</b>	2.1 Biochemical composition and nutritional value of fish. 2.2 Fish decomposition- Post mortem changes and rigor mortis, Causes of spoilage. 2.3 Fish handling methods: Transferring catch from gear to vessel, Washing/Sorting, Bleeding/gutting, 2.4 Traditional methods of fish processing: - Icing, Drying, Salting, Smoking, 2.5 Fish Products and byproducts: Fish Oil, Fish meal, Fish silage, Fish protein, Fish glue, Fish leather.	<b>08</b>
<b>Unit III</b>	3.1 Principles and importance of fish preservation. 3.2 Fish Preservation techniques: Icing of fish, different types of ice and their manufacture. CSW, RSW. 3.3 Different types of freezers. Quality changes during frozen storage. 3.4 Basic refrigeration cycle, Canning: Unit steps in canning and their significance. 3.5 Packaging of fish and fishery products:- Packaging materials; basic films and laminates,	<b>08</b>
<b>Unit IV</b>	4.1 Fish Markets and Fish market structure. 4.2 Types of market: wholesale, terminal, retail, and fairs. Functions: Selling, transportation, storage, gradation, money transaction. 4.3 Marketing system: Use flows, physical flows and channel flows. 4.4 Government and Fishermen's Co-operative Societies, integration, marketing efficiency. 4.5 Price determination, Institutional Support to fisheries, Crop Insurance.	<b>07</b>
<b>Unit V</b>	5.1 Quality Assurance and Export of Fishery Products: Quality control – basic concepts, quality and quality control.	<b>07</b>

	<p>5.2 Sanitation procedures in fish processing plants.</p> <p>5.3 Risk factors in fish bio-toxins, seafood pathogens, endogenous parasites.</p> <p>5.4 Methods of evaluating fish freshness and quality – organoleptic, physical, chemical, microbiological and instrumental methods.</p> <p>5.5 Quality standards in India and major importing countries like USA, Japan and EU.</p>	
<b>Unit VI</b>	<p>6.1 Aquarium design and Construction: Introduction to aquarium.</p> <p>6.2 Design and construction of home and public aquaria (freshwater and marine), Aquarium accessories</p> <p>6.3 Aquarium Management: Setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes.</p> <p>6.4 Aquarium maintenance and water quality management. Control of snail and algal growth. Handling, care, packing and transportation of fishes</p> <p>6.5 Freshwater Ornamental Fishes: Species of ornamental fishes - their taxonomy and biology- Live bearers, Gold fish and koi,</p>	<b>08</b>

**Suggested Readings:**

1. ADCP (Aquaculture Development and Co-ordination Programme). 1980.
2. Badapanda K.C. Fishing Crafts and Gear technology. Narendra Publishing House.
3. Balachandran KK. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publ. House.
4. Biswas K.P. Advancement in fish, fisheries and technology. Narendra Publishing House.
5. Charls L. Cutting, 2002. Fish Processing and Preservation.
6. Clucas IJ. 1981. Fish Handling, Preservation and Processing in the Tropics. Parts I, II. FAO.
7. Fennema K, Powrie WD & Marth EH. 1973. Low Temperature Preservation of Foods and Living Matter. Marcel Dekker.
8. Gopakumar K. (Ed.). 2002. Text Book of Fish Processing Technology. ICAR.
9. Govindan T.K. Fish Processing Technology. Oxford & IBH Pub. Co.
10. Hall GM. (Ed). 1992. Fish Processing Technology. Blackie.
11. Hall GM. (Ed). 2011. Fish Processing –sustainability and new opportunities. Wiley Blackwell.
12. Hand book of Fisheries and Aquaculture. 2006. Indian Council of Agricultural Research. New
13. Hersom AC & Hulland ED. 1980. Canned Foods. Chemical Publ. Co.
14. Hertrampf JW & Pascual FP. 2000. Handbook on Ingredients for Aquaculture Feeds. Kluwer.
- Houlihan D, Boujard T & Jobling M. 2001. Food Intake in Fish. Blackwell.
15. Larousse J & Brown BE. 1997. Food Canning Technology. Wiley VCH.
16. Lavens P & Sorgeloos P. 1996. Manual on the Production and Use of LiveFood for Aquaculture. FAO Fisheries Tech. Paper 361,
17. M.N. Moorjani, 1998. Fish Processing in India. ICAR, New Delhi,
18. Manual on Fish Canning. FAO Fisheries Tech. Paper 285.
19. Post harvest technology of freshwater fish. 2009. Central institute of fisheries technology. Cochin.
20. Saroj K. Swain, Sarangi N. and Ayyappan S. 2010. Ornamental Fish Farming ICAR
21. Sen DP. 2005. Advances in Fish Processing Technology. Allied Publ.
22. Thabrow De WV. 1981. Popular Aquarium Plants. Thornbill Press.
23. Ujwala Jadhav (2010). Aquaculture Technology and Environment. Publ. PHI Publication.
24. Venugopal V. 2006. Seafood Processing. Taylor & Francis.

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<b>Course: Pr- Major Laboratory 8 (DSC I.4- General Parasitology + DSE IV Fisheries-II- Fish Harvesting, Marketing and Aquarium Management )</b>		
<b>Subject Code: 3 ZOO 8</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100 (External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for General Parasitology**

1. Slides / museum specimens of selected parasites of representative groups of protozoans and helminths (Plasmodium, Trypanosoma, Leishmania, Ascaris( male & female), Hookworm , Ancylostoma sp., Wucheria sp..
2. Study of life cycles and morphology of Vectors: Anopheles, Culex and, Aedes species (Adults, eggs, larvae and pupae), house fly, cockroach, bed bug.
3. Ticks and mites: Argus, Sarcoptes, Psoroptes , Hemaphysalis spinigera
4. Collection of ticks and mites from domestic animals.
5. Histological preparation of parasites in tissues.
6. Preparation of blood smear for protozoan / nematode parasites.

**B) Practicals for Fisheries-II- Fish Harvesting, Marketing and Aquarium Management**

1. Study of local traditional fishing gears.
2. Identification of fishing crafts, gears, fishing accessories (floats/sinkers/hook/synthetic and natural fibres, twines, ropes, iron wares).
3. Evaluation of freshness of fish
4. Determination of condition factor of a fish.
5. Quality control of fishes: Crude protein analysis of fish muscle by lowry method.
6. Identification of tools and accessories used in aquarium fabrication and maintenance.
7. Construction of a glass aquarium.
8. Identification of aquarium fishes.
9. Identification of aquarium plants
10. Visit to fish processing plant: Submission of a detailed report of visit.
11. Local fish market Survey and submission of its report

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) General Parasitology**

1. Identification of spots. .... 12 Marks
2. Study of life cycle/morphological identification of vectors..... 08 Marks

**Experiments from Section B) Fisheries-II- Fish Harvesting, Marketing and Aquarium Management**

3. Experiments (Expt. 1or 2 or 3).....12 Marks
4. Spotting (1 fishing accessory, 1 aquarium tool, 1 Aquarium fish, 1 aquarium plant) 08 M
5. Viva Voce ..... 10 Marks

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**TOTAL** **50 Marks**

**Internal Practical Marks**

1. Certified Practical Record : 20 marks
2. Submission of collection of ticks and mites : 10 marks
3. Submission of Reports (Visit to fish processing plant: and Local fish market Survey: 05 M
4. Setting of Aquarium : 05 Marks
5. Student Performance : 10 marks

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**TOTAL** **50 Marks**  
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Course: DSE IV Animal Physiology – II Th-Major Elective		
Subject Code: 4 ZOO 4	No. of Credits: 3	No. of hours per week: 3
Exam duration: 3Hrs	Maximum Marks: 100 (External:60 Internal:40)	Total No. of contact hours: 45

**CO's: 4 ZOO 4**

- 1: Animal physiology gives the knowledge of biological processes through the investigation of physiological processes.
- 2: It enables to understand the chemical and molecular processes that occur in and between cells.
- 3: It also provides knowledge about the theoretical processes related to hormonal action.
- 4: Trains the students to perform laboratory exercises in Animal physiology that is applicable to Pathology laboratory, medicine, forensics and pharmaceutical industry.

Units	Syllabus Content	Hours
<b>Unit I</b>	<p><b>Muscle Physiology:</b></p> <p>1.1 Ultra structure of skeletal muscle and Sarcotubular system.</p> <p>1.2 Ion distribution.</p> <p>1.3 Types of muscle contraction.</p> <p>1.4 Muscle proteins.</p> <p>1.5 Physical and Chemical Properties skeletal muscles.</p> <p>1.6 Sliding filament theory of muscle contraction.</p> <p>1.7 Role of Ca<sup>++</sup>, Calcium receptors, Calmodulin and calcium pump.</p>	<b>8</b>
<b>Unit II</b>	<p><b>Nerve Physiology:</b></p> <p>2.1 Ultra structure of neuron, Electrical properties of nerve.</p> <p>2.2 Ionic concentration in the cytoplasm (Donnan equilibrium system).</p> <p>2.3 Action potential, Resting potential, Depolarization and Repolarization.</p> <p>2.4 Local circuit theory, ionic theory, Saltatory and nerve conduction.</p> <p>2.5 Ultrastructure of synapse, Biosynthesis, storage and release of acetylcholine.</p> <p>2.6 Acetylcholine receptor and role of acetylcholine esterase.</p> <p>2.7 Types of neurotransmitters.</p>	<b>7</b>
<b>Unit III</b>	<p><b>Homeostasis Physiology:</b></p> <p>3.1 Homeostasis Physiology: Water contents and distribution</p> <p>3.2 Composition of ECF (Extra cellular fluid) and ICF (Intracellular fluid)</p> <p>3.3 Abnormal water and electrolyte metabolism and water intoxication.</p> <p>3.4 Maintenance of pH.</p> <p>3.5 Components of Homeostatic Control system.</p> <p>3.6 Reflexes, Local Homeostatic Responses.</p>	<b>7</b>
<b>Unit IV</b>	<p><b>Control of Homeostasis:</b></p> <p>4.1 Nitrogen excretion among different animal Groups.</p> <p>4.2 Mechanism of calcium and phosphate Homeostasis.</p> <p>4.3 Homeostasis of iron maintenance.</p> <p>4.4 Homeostasis mechanism of fever.</p> <p>4.5 Homeostatic mechanism of minerals.</p> <p>4.6 Homeostasis and antidiuretic hormone</p>	<b>8</b>
<b>Unit V</b>	<p><b>Thermoregulation and Osmoregulation:</b></p> <p>5.1 Adaptation and Acclimatization. Biological Rhythms in body temperature.</p> <p>5.2 Balance in the Homeostasis of chemicals</p> <p>5.3 Homeostatic control systems - feedback.</p>	<b>8</b>

	5.4 Basic thermoregulatory mechanism in Poikilotherms and endotherms. 5.5 Ectothermic adaptations to extreme temperatures. 5.6 Osmoregulatory mechanism in stenohaline and euryhaline species and in Terrestrial environment.	
<b>Unit VI</b>	<b>Senses and Receptors:</b> 6.1 Mechanoreceptors. 6.2 Photo receptors. 6.3 Thermo receptors. 6.4 Chemoreceptors. 6.5 Electroreceptors. 6.6 Magneto receptors	<b>7</b>

**Suggested Reading:**

- 1 Baileys: Text book of Histology
- 2 Bell Davidson: Text book of physiology and Biochemistry
- 3 Bolander F.F.: Molecular endocrinology
- 4 Clerk E.E .C. Isolation and identification of Drugs in pharmaceutical of body fluid and post martical Vol.I & II.
- 5 Cole S. W.: The practical physiological chemistry.
- 6 Cooper: Poisoning by drugs and chemicals.
- 7 Eckert, Marsall: Animal physiology mechanism and Adaptations
- 8 Eckert & Ranadak: Animal physiology (CBS) 2nd ED (1978)
- 9 Garden M.S.: Animal physiology principal and Adaptations.
- 10 Hara & Oserburg; An introduction to crimminalistie.
- 11 Hill R.W.: Comparative physiology of animals
- 12 HoarW.S.: General and comparative physiology.
- 13 Houssa: Human physiology (McGraw Hill Books Compny)
- 14 Hunter& Bornford: Hutchisons Clinical methods
- 15 Hynes: The Biology of polluted water.
- 16 Jacobs M. B.: The analytic toxicology of inorganic poison
- 17 Keil J.B.,Samson Wrightsa, : Applied Physiology
- 18 Heil E. Joets N.: Physiology (Oxford Uni press ) (1982)
- 19 Klein L: River pollution, causes& effects
- 20 Madhu Raj: Environmental Management of toxic and hazardous chemicals
- 21 Mill peter J.: Comparative neurobiology (EdHrbord London
- 22 Modi N.J.: Text Book of toxicology
- 23 Mitchell P.H.: Text Book of General physiology.

- 24 Norman A.W.: Hormones.
- 25 Odum: Fundamental of ecology.
- 26 Osterbong: The crime laboratory
- 27 Philips G.: Environmental physiology.
- 28 Prosser C.L.: Comparative animal physiology.
- 29 Ramkumar: Environmental Biodegradation.
- 30 Ramkumar: Environmental Chemical hazards.
- 31 Robert & Cosselin: First & emergency treatment and clinical toxicology of commercial product.
- 32 Seinfeld J.J.: Air pollution (A.P.)
- 33 Smith ptterson: Text Book of physiology (ELBS) Read & Scratched (1988) 11th Ed..
- 34 Sern A.C.: Air pollution (A.P.)
- 35 Stewart & stratman: Toxicology mechanism and analytical methods
- 36 Theils: Clinical Toxicology.
- 37 Tomb: An introduction to invertebrate endocrinology (Academic press)
- 38 West Best & Taylor, s: Physiological Basis of medical practice.
- 39 White R. Steions.: Pesticides in environment Vol.1
- 40 Wilsom J. A.: Principles of animal physiology.
- 41 Wod Densus W.: Principles of animal physiology. (Ed. Arbod) Lond

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<b>Course: Pr- Major Laboratory 8</b>		
<b>(DSC I.4- General Parasitology + DSE IV Animal Physiology – II)</b>		
<b>Subject Code: 3 ZOO 8</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for General Parasitology**

1. Slides / museum specimens of selected parasites of representative groups of protozoans and Helminths (Plasmodium, Trypanosoma, Leishmania, Ascaris (male & female), Hookworm, Ancylostoma sp., Wucheria sp..
2. Study of life cycles and morphology of Vectors: Anopheles, Culex and, Aedes species (Adults, eggs, larvae and pupae), house fly, cockroach, bed bug.
3. Ticks and mites: Argus, Sarcoptes, Psoroptes , Hemaphysalis spinigera
4. Collection of ticks and mites from domestic animals.
5. Histological preparation of parasites in tissues.
6. Preparation of blood smear for protozoan / nematode parasites.

**B) Practicals for Animal Physiology – II**

1. Properties of saliva. Isolation and identification of rumen microorganisms.
2. Estimation of rumen ammonia and blood urea under various physiological conditions.
3. Normal and abnormal constituents of urine.
4. Microscopic examination of urine.
5. Preparation and examination of blood smear to study blood cells.
6. Differential leucocytes count.
7. Histochemical demonstration of-
  - Carbohydrates,
  - Proteins,
  - Lipids.
  - Nucleic acids,
  - Acid and alkaline phosphatase.
8. Separation of proteins by paper and gel electrophores
9. Qualitative analysis of urea, ketone bodies and salts

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) General Parasitology**

- |   |          |
|---|----------|
| 1. Identification of spots. ....                                    | 12 Marks |
| 2. Study of life cycle/morphological identification of vectors..... | 08 Marks |

**Experiments from Section B) Animal Physiology – II**

- |                                      |          |
|--------------------------------------|----------|
| 3. Major physiology experiments..... | 12 Marks |
| 4. Minor physiology experiments..... | 08 Marks |
| 5. Viva Voce .....                   | 10 Marks |

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<b>TOTAL</b>	<b>50 Marks</b>
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**Internal Practical Marks**

- |  |            |
|--|------------|
| 1. Certified Practical Record                  | : 20 marks |
| 2. Submission of collection of ticks and mites | : 10 marks |
| 3. Survey based on physiology practical        | : 10 marks |
| 4. Student Performance                         | : 10 marks |

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<b>TOTAL</b>	<b>50 Marks</b>
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<b>Course: DSE IV Molecular Biology-II Th-Major Elective ( Molecular Immunology)</b>		
<b>Subject Code: 4 ZOO 4</b>	<b>No. of Credits: 3</b>	<b>No. of hours per week: 3</b>
<b>Exam duration: 3Hrs</b>	<b>Maximum Marks: 100 (External:60 Internal:40)</b>	<b>Total No. of contact hours: 45</b>

**CO's: 4 ZOO 4**

- 1: Molecular Immunology gives the knowledge of biological defence processes through the investigation of molecular mechanisms.
- 2: It enables to understand the physiological and molecular mechanisms that occur in the body during host defence to parasitic infections.
- 3: It gives an idea about various aspects of vaccines and their development.
- 4: Trains the students to perform laboratory exercises in Molecular Immunology that is applicable to medicine and pharmaceutical industry.

<b>Units</b>	<b>Syllabus Content</b>	<b>Hours</b>
<b>Unit I</b>	<p><b>The Immune System:</b></p> <p>1.1 Innate and adaptive immunity.</p> <p>1.2 Cells and lymphoid tissues of the immune system.</p> <p><b>Antigens and Antibodies:</b></p> <p>1.3 Factors affecting antigenicity.</p> <p>1.4 Epitopes, Haptens, Adjuvants, Superantigens.</p> <p>1.5 Structural features and biological properties of immunoglobulins, Immunoglobulin variants.</p> <p>1.6 Antibody mediated effector functions.</p>	<b>08</b>
<b>Unit II</b>	<p><b>Complement System:</b></p> <p>2.1 Pathways of complement activation, Late steps of complement activation.</p> <p>2.2 Receptors for complement proteins, Regulation and functions of complement system.</p> <p><b>Cytokines:</b></p> <p>2.3 General properties, Cytokines of hematopoiesis, innate and adaptive immunity.</p> <p>2.4 Cytokine receptors, Cytokine receptor-mediated signal transduction.</p> <p><b>Major Histocompatibility Complex (MHC):</b></p> <p>2.5 Genomic organization, Diversity of MHC.</p> <p>2.6 Structure of MHC molecules, Processing of protein antigens, Binding of peptides to MHC molecules.</p>	<b>07</b>
<b>Unit III</b>	<p><b>Biology of T- and B-lymphocytes:</b></p> <p>3.1 T-Cell maturation, activation, differentiation, and effector functions.</p> <p>3.2 Structure of TCR and TCR complex, Generation of TCR diversity and T-cell coreceptors.</p> <p>3.3 Signal transduction by TCR complex.</p> <p>3.4 B-cell maturation, activation, differentiation.</p> <p>3.5 Structure and signal transduction by BCR complex.</p>	<b>08</b>
<b>Unit IV</b>	<p><b>Techniques in Immunology:</b></p> <p>4.1 Enzyme-linked immunosorbent assay (ELISA), Radioimmunoassay (RIA).</p> <p>4.2 Hybridoma technology, Applications of monoclonal antibodies.</p> <p><b>Immunization:</b></p> <p><b>4.3 Active Immunization (Vaccines):</b> Live attenuated vaccines, <b>Inactivated or killed vaccines, Subunit vaccines, Conjugated polysaccharide vaccines, Recombinant</b></p>	<b>07</b>

	<b>vector vaccines, DNA vaccines.</b> <b>4.4 Passive Immunization:</b> Passive immunization through placental antibody transfer and colostrum,	
<b>Unit V</b>	5.1 <b>Autoimmunity:</b> Immunologic tolerance, Pathogenesis of autoimmunity. 5.2 <b>Autoimmune Diseases:</b> Organ-specific autoimmune diseases, Systemic autoimmune diseases. 5.3 <b>Immunodeficiency Disorders:</b> Severe combined immune deficiencies (SCIDs), Acquired immunodeficiency syndrome (AIDS). 5.4 <b>Hypersensitivity Reactions:</b> Type I, II, III and IV.	<b>07</b>
<b>Unit VI</b>	<b>Transplantation Immunology:</b> 6.1 Immune responses to allografts, Mechanisms of allograft rejection. 6.2 Prevention of allograft rejection. <b>Tumor Immunology:</b> 6.3 Tumor antigens. 6.4 Immune responses to tumors. 6.5 Evasion of immune responses by tumors.	<b>08</b>

**Suggested Reading:**

1. Abbas Abul K. *et al.* **Cellular and Molecular Immunology**, 6-10/Ed. Elsevier.
2. Punt Jenni *et al.* **Kuby Immunology**, 6-8/Ed. W. H. Freeman and Company New York.
3. Coico Richard *et al.* **Immunology-A Short Course**, 6-7/Ed. Wiley-Blackwell.
4. Tizard Ian R. **Immunology–An Introduction**, 4/Ed. Saunders College Publishing.
5. Tizard Ian R. **Veterinary Immunology**, 10/Ed. Elsevier.
6. Gangal Sudha *et al.* **Textbook of Basic and Clinical Immunology**. Orient Blackswan.
7. Male David *et al.* **Immunology**, 8/Ed. Mosby Elsevier.
8. Peter J. Delves *et al.* **Roitt’s Essential Immunology**, 13/Ed. Wiley-Blackwell.
9. Rich Robert R. *et al.* **Clinical Immunology-Principles and Practice**, 5/Ed. Elsevier.
10. Flajnik Martin F. *et al.* **Paul’s Fundamental Immunology**, 8/Ed. Wolters Kluwer.

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<b>Course: Pr- Major Laboratory 8</b>		
<b>(DSC I.4- General Parasitology + DSE IV Molecular Biology-II Molecular Immunology)</b>		
<b>Subject Code: 3 ZOO 8</b>	<b>No. of Credits: 2</b>	<b>No. of hours per week: 4</b>
<b>Exam duration: 6 Hrs</b>	<b>Maximum Marks: 100</b> <b>(External:50 Internal:50)</b>	<b>Total No. of contact hours: 60</b>

**A) Practicals for General Parasitology**

1. Slides / museum specimens of selected parasites of representative groups of protozoans and Helminths (Plasmodium, Trypanosoma, Leishmania, Ascaris (male & female), Hookworm, Ancylostoma sp., Wucheria sp..
2. Study of life cycles and morphology of Vectors: Anopheles, Culex and, Aedes species (Adults, eggs, larvae and pupae), house fly, cockroach, bed bug.
3. Ticks and mites: Argus, Sarcoptes, Psoroptes , Hemaphysalis spinigera
4. Collection of ticks and mites from domestic animals.
5. Histological preparation of parasites in tissues.
6. Preparation of blood smear for protozoan / nematode parasites.

**B) Practicals for Molecular Biology-II Molecular Immunology**

1. Blood group identification- A, B, AB, O and Rh.
2. Screening of antigen and antibody-Antigen-antibody pattern (Ouchterlony double diffusion).
3. Estimation of antigen and antibody content in the samples by Radial Immunodiffusion.
4. Counter-current immunoelectrophoresis.
5. Dot-ELISA.
6. Rocket immunoelectrophoresis.
7. Immunological diagnosis of pregnancy.
8. Preparation of tissue sections and staining of thymus, spleen, and lymph nodes (Source of tissue: Animal tissues from local recognized slaughter houses/ poultry farms/ fish market etc)

**The examinee shall be required to produce at the practical examination the following:**

Practical record book duly signed by teacher in-charge and certified by the Head of the Department as a bonafide work of the examinees.

**DISTRIBUTION OF PRACTICAL MARKS**

**External Practical Marks**

**Experiments from Section A) General Parasitology**

1. Identification of spots. .... 12 Marks
2. Study of life cycle/morphological identification of vectors..... . 08 Marks

**Experiments from Section B) Molecular Biology-II Molecular Immunology**

3. Major Immunology experiments..... 12 Marks
4. Minor Immunology experiments..... 08 Marks
5. Viva Voce ..... 10 Marks

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**TOTAL** **50 Marks**

**Internal Practical Marks**

1. Certified Practical Record : 20 Marks
2. Submission of collection of ticks and mites : 10 Marks
3. Submission of Stained Permanent Slides : 10 Marks
4. Student Performance : 10 Marks

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**TOTAL** **50 Marks**

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## **Guidelines for PG Research Project (Phase I and Phase II)**

- The Research proposal will be evaluated only at college / department level RAC (Research Advisory Committee) and there should be no need to go to the RRC at the University level.
- The department/ college may put up the list of Research Projects (Titles) on the website of concerned RAC/ College / Department in public domain for transparency and information of stakeholders and concerned people.
- All students shall adhere to the following reference guidelines in order to select, pursue and execute
- Research Project during the third and fourth semester of PG Programme. Further, they should adopt the following guidelines for preparing and submitting the Report/Thesis of the Research Project.
- The examiners / evaluators are requested to assess the Research Project Thesis on the basis of the following parameters, as applicable.

### **1. Research Project Title**

Title should be clear and concise with appropriate variables (shows accurately the subject/focus area and scope of study through important “keywords” from the subject

The following parameters can be used to help formulate a suitable research project title:

1. The purpose of the research
2. The type of the research
3. The methods used

The initial aim of a title is to capture the reader’s attention and to draw his or her attention to the research problem being investigated.

Title of Research project should have several characteristics as follows

- Avoid using abbreviations.
- Use words that create a positive impression and stimulate reader interest.
- Use current nomenclature from the field of study.
- Identify key variables, both dependent and independent.
- Suggest a relationship between variables which supports the major hypothesis.
- Titles are usually in the form of a phrase, but can also be in the form of a question.
- Use correct grammar and capitalization with all first words and last words capitalized, include in the first word of a subtitle. All nouns, pronouns, verbs, adjectives, and adverbs that appear between the first and last words of the title are also capitalized. Simply put, a student must point out several things: (1) what; (2) how; and ideally, (3) why in a Title of the research project.

### **2. Table of Contents, Chapterization Scheme of the Research Project Thesis, List of Tables, List of Figures**

### **3. Research Project Summary (250 words) followed by Keywords**

### **4. Introduction**

Origin of the proposal, Motivation for undertaking research, brief overview explaining the background and importance of the study

### **5. Statement of the Problem Specifically what the researcher wants to know**

### **6. Purpose/Significance/Importance of the Proposed Research in the context of the current status**

Topic is critical in discipline. Aim of the proposed work is Unexplored/underexplored Importance/justification of the proposed work. What the researcher hopes to achieve by conducting the study. As part of the purpose of the study, there should be justification for conducting the project. This



section should exhibit a clear understanding of what makes your study significant and why it should be conducted.

**7. Definition of Terms, if applicable –**

Clarification of any terminology in the study/research that may not be commonly known; provides a similar interpretation for all readers of the study

**8. Delimitations, Limitations, and Assumptions (if applicable)**

A brief statement identifying the delimitations, limitations, and assumptions associated with the study/research should be provided.

**Delimitations** – factors that were controlled by the researcher

**Limitations** – factors that were not under the control of the researcher

**Assumptions** – factors that the researcher assumes were taken into consideration.

**9. Critical Review of Non-Patent and Patent Literature till date**

The student should provide a breakdown of sub-topics influencing the processes of the research project. Each sub-topic should contain a thorough examination of the literature that influences or is representative of current research on that subtopic. The literature review should collectively support the process and purpose of the study. A theoretical framework as applicable to the field of study may be included here. Include Journal Articles (non-patent literature) and Patents (Indian and International) literature (granted/published), if applicable. For Patent literature, student may use, for example, Google Patents Advanced Search. Student shall only include reported research work published in the Journals, which are listed in UGC CARE List Group-I and UGC CARE List Group-II.

**10. Theoretical Framework, Research Questions, Hypothesis, elements (As applicable to the Research)**

Hypothesis must be Clear, corresponding to objectives and testable. Derived from residue of Review of Literature

**11. Problem Definition (Formulation)**

**12. Research Objectives**

(Align Research Objectives with Research Gaps, Research Questions, etc.)

(Research Objectives must be specific, measurable, achievable, realistic, time constrained) [S.M.A.R.T.]

**13. Resources/facilities accessible to execute the project**

**14. Research Methodology**

This section should clearly present each aspect of the process by which the study/research will be completed. Every attempt should be made to leave no question as to the procedures used to complete the study. Proper scientific methods should be used for this aspect of the study/research. Methods, Subjects, Instrumentation, Procedures, etc. (if relevant and applicable) Ensure that the research methodologies are appropriate for answering the research questions and that they are feasible within the available resources and time frame.

**15. Feasibility Study of the Proposed Research Project Plan for planning and fruitful execution of Research Project.**

**16. Describe Research Design (as applicable to the specific type of Research)**

Correlational	Causal	Comparative	interviews
Quasi-Experimental	Experimental/ Laboratory	Simulation	surveys
Empirical	Meta-analytic	analytic	Participant observations
Applied	Basic/Fundamental	Qualitative/Creative	Oral history
Quantitative	Classification	Field	Archival research
Comparative	Source Criticism	Focus Groups	Case studies

(or any other type of research not covered above)

**17. Sampling (if applicable)** – describe the aspects of the cases on which data collection and analysis will focus (where relevant), Indicate how access to the study population will be achieved .

**18. Variables** (As applicable to the Research Project with justification) – describe aspects of the cases on which data collection and analysis will focus (where relevant).

Dependent	Quantitative	Latent
Independent	Qualitative (categorical)	Continuous in time
Control	Observable	Discrete time

**19. Methods of Data Collection (as applicable)**

**20. Organization of Work Elements**

Provide a timeline listing the order for all the major steps of the study and indicate the approximate amount of time needed for each step (Time schedule of activities giving major milestones, Time schedule of activities through Bar diagram)

**21. Data Analysis Procedures and Interpretation, if applicable:**

Outline the data analysis methods (Qualitative as well as Quantitative) and how the results will be interpreted. Verify that the methods are appropriate for the data to be collected.

**22. Results/Findings:**

Evaluate the presentation of results, including data tables, graphs, and figures. Verify if the results address the research questions, properly and if they are supported by the data collected.

**23. Conclusions, suggestions/recommendations:**

List the conclusions drawn from the study and whether they are supported by the evidence presented in the project report.

**24. Discussion:**

Check the interpretation of the results and the extent to which the findings align with the stated objectives. The discussion should include critical analysis and potential limitations.

**25. Future Research Directions/ Recommendations for further Research**

Provide recommendations to further research on this topic or how parts of the study/research undertaken could be improved upon. If researcher found as a result of his/her study that another topic should be looked at in order to offer more insight into this topic, then he/she should suggest that at this time. It is important that this part of the conclusion chapter incorporates the implications of the findings drawn from the Research Project in terms of other research in the specific area of study, investigated by the researcher.

**26. Research Outcomes with beneficiaries**

Outcome of research should result into Product Patent/ Process Patent/Design Patent and/or High quality Publications in Journals listed in UGC CARE List Group-I and UGC CARE List Group II. (Also list the possible beneficiaries of the research)

The outcome of the conducted research in PG programme is likely to be patented and/or publishable in the journals indexed in UGC CARE List Group-I and UGC CARE List Group-II.

**27. Sustainability in Research Project (if applicable, please specify)**

- Human sustainability
- Social sustainability
- Economic sustainability
- Environmental sustainability (issues related to energy, Carbon footprint assessment, climate and biodiversity)
- Life Cycle Assessment (LCA). LCA enables the assessment of environmental impacts of a service or

product by taking into account all the stages of its life cycle according to different criteria, including but not limited to carbon dioxide CO<sub>2</sub> measurement.

- Reproducibility of the protocols; results; research materials: product, information, data, software, Codes, etc.
- Use of Green artificial intelligence, which seeks to reconcile powerful computing with environment friendly research
- Adoption of Eco-friendly practices

**28. Originality/Novelty of the project (Justify one or more of the following as applicable to the Research work)**

a) Incremental improvement	b) Devise New investigative methods /analysis / synthesis
c) Substantial/radical improvement	d) Devise new system/model/product/process/ machine/ article of manufacture/composition of matter/new and useful improvement of any of these
e) Discover new information/model/system	f) Apply New Methods/Approach/Techniques/ Algorithms
g) Provide new Technical Solution to a Problem	h) Create New Interpretations
i) Modify existing theories/ systems/ models /Algorithms /Interpretations	j) Provide additional support for existing theories/models/interpretations
k) Analyze phenomena/Results of Research in new ways	l) Disprove the existing theories/ models/ interpretation
m) Generation of New Data	n) Devise new original and ornamental design for an article of manufacture
o) Invention or discovery and reproduction of any distinct and new variety of plant (Botany)	p) Any other aspect not covered above

**29. Plagiarism/Similarity Check**

This requires that the researcher's work:

- Provides a full and complete representation of any scholarly findings
- Credits the contributions of other researchers, colleagues, co-workers, etc.
- Respects diversity of opinion

**Misconduct in research and writing is defined as**

- The fabrication, falsification, plagiarism, or other practices that seriously deviate from those commonly accepted within the scientific, artistic, and academic professional communities.
- Plagiarism involves the intentional appropriation of another's work, including ideas or phrasing of words, without crediting the source.
- Please include the similarity analysis report or plagiarism check report of the Entire Research Project by Urkund (or Turnitin or iThenticate or any other software available at the Knowledge Resource Centre of Sant Gadge Baba Amravati University, Amravati).
- This will ensure the originality of the Research work. UGC's new anti-plagiarism policy allows up to 10% content similarity. With similarity above it, students will be asked to revise and resubmit the synopsis.

[Reference: University Grants Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations, 2018.]

**30. Prior Approval from the IAEC registered with the CPCSEA (The Committee for Control and Supervision of Experiments on Animals) to be submitted to the Ph.D. Cell along with the Research Synopsis (If Applicable to the Research Work)**

- As per the "Breeding of and Experiments on Animals (Control and Supervision) Rules, 1998", an Institutional Animal Ethics Committee (IAEC) is needed for control and supervision of experiments on animals performed in the Institute/Research Laboratory. The IAEC must be registered with the CPCSEA.
- Prior approval of the IAEC is mandatory for all types of research proposals involving small animal experimentation before the start of the study. This Committee also monitors research throughout the study and after completion of the study through periodic reports besides regular visits to the research faculty animal house and laboratories where the experiments are conducted. This also ensures compliance with all regulatory requirements, rules, guidelines and laws related to animal experiments.
- A copy of the prior approval of the IAEC, which is already registered with the CPCSEA must be enclosed along with the Research Synopsis

**31. References/Bibliography**

- Credibility of Sources of literature: Journals used in the literature review must be indexed in the UGC- CARE Group-II or UGCCARE List Group-I.
- References/ bibliographies must be listed in uniform standard style (APA/ MLA/Chicago/IEEE/MHRA or Harvard)
- Ensure that all references are properly referred to in the running text and Seminal Research Articles are included in the references.

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