

**Kavayitri Bahinabai Chaudhari  
North Maharashtra University, Jalgaon**

॥अंतरी पेटवू ज्ञानज्योत॥



'A' Grade  
NAAC Re Accredited  
(1<sup>st</sup> Cycle)

**SYLLABUS**

for

**Master of Science (M. Sc.)**

**Zoology**

**Choice Based Credit System**

**(Proposed Structure)**

**(Outcome Based Curriculum)**

**2021 - 2022**

## Program at a Glance

Name of the program (Degree) :	M. Sc. (Zoology)
Faculty	Science and Technology
Duration of the Program	Two years (four semesters)
Medium of Instruction and Examination	English
Exam Pattern	60 : 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	40% in each exam separately \ (Separate head of passing)
Evaluation mode	CGPA
Total Credits of the program	88 (64 core credits including 4 credits of project/dissertation, 08 skill enhancement credits, 08 subject elective credits and 08 audit credits)

:

:

**Summary of Distribution of Credits under CBCS Scheme  
for M.Sc. Zoology**

<b>Sr. No</b>	<b>Type of course</b>	<b>Sem I</b>	<b>Sem II</b>	<b>Sem III</b>	<b>Sem IV</b>
01	Core	<b>16</b>	<b>16</b>	<b>16</b>	<b>12</b>
02	Skill based	<b>04</b>	<b>04</b>	-	-
03	Elective	-	-	<b>04</b>	<b>04</b>
04	Project	-	-	-	<b>04</b>
05	Audit	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>
06	Total Credits	<b>22</b>	<b>22</b>	<b>22</b>	<b>22</b>

<b>Subject Type</b>	<b>Core</b>	<b>Skill based</b>	<b>School Elective</b>	<b>Project</b>	<b>Audit</b>	<b>Total</b>
<b>Credits</b>	<b>60</b>	<b>08</b>	<b>08</b>	<b>04</b>	<b>08</b>	<b>88</b>

**Total Credits = 88**

## KBC North Maharashtra University Jalgaon

### M. Sc. Zoology

Choice Based Credit System (Outcome Based Curriculum) with effect from 2021 -2022

#### Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	4	8 + 8	<b>16</b>	1	4 + 0	4	1	2	2	<b>22</b>
II	4	12 + 4	<b>16</b>	1	4 + 0	4	1	2	2	<b>22</b>
III	4	8 + 8	<b>16</b>	1	4 + 0	4	1	2	2	<b>22</b>
IV	4	8 + 8	<b>16</b>	1	4 + 0	4	1	2	2	<b>22</b>
<b>Total Credits</b>	<b>64</b>			<b>16</b>			<b>8</b>			<b>88</b>

(T= Theory; P=Practical)

### Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	<b>Prerequisite and Core Courses</b>									
	Theory	4	2	4	3	4	2	4	2	36
	Practical	4	2	4	1	4	2	4	2	28
(B)	<b>Skill Based / Subject Elective Courses</b>									
1	Theory /Practical	4	1	4	1	4	1	4	1	16
(C)	<b>Audit Course (No weightage in CGPA calculations)</b>									
1	Practicing Cleanliness	2	1	--	--	--	--	--	--	2
2	Personality and Cultural Development Related Course	--	--	2	1	--	--	--	--	2
3	Technology Related + Value Added Course	--	--	--	--	2	1	--	--	--
4	Professional and Social + Value Added Course	--	--	--	--	--	--	2	1	2
	<b>Total Credit Value</b>	14	6	14	6	14	6	14	6	88

#### List of Audit Courses (Select any ONE course of Choice from Semester II; Semester III and Semester IV)

Semester I (Compulsory)		Semester II (Choose One)		Semester III (Choose One)		Semester IV(Choose One)	
		Personality and Cultural Development		Technology + Value Added Course		Professional and Social + Value Added Course	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Sport Activities	AC-301B	Cyber Security	AC-401B	Current Affairs
		AC-201C	Yoga	AC-301C	Seminar + Review Writing	AC-401C	Seminar + Review Writing
		AC-201D	Music	AC-301D	Biostatistics	AC-401D	Intellectual Property Rights (IPR)

## *Semester-wise Course Structure of M.Sc. Zoology*

### *Semester I*

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
Zoo-101	Core	Structure and Functional Anatomy of Invertebrates	4	--	4	40	--	60	--	4
Zoo-102	Core	Cellular organization and Developmental Biology	4	--	4	40	--	60	--	4
Zoo-103	Core	Practical I	--	4+4	8	--	40	--	60	4
Zoo-104	Core	Practical II	--	4+4	8	--	40	--	60	4
Zoo-105	Skill Based	Goatery	4	--	4	40	--	60	--	4
Zoo AC-101	Audit Course	Practicing Cleanliness	--	2	2	--	100	--	--	2
<b>Total Credit for Semester I: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)</b>										

### *Semester II*

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
Zoo-201	Core	Structure and Functional Anatomy of Vertebrates	4	--	4	40	--	60	--	4
Zoo-202	Core	Biochemistry	4	--	4	40	--	60	--	4
Zoo-203	Core	Tools and Techniques in Biology	4	--	4	40	--	60	--	4
Zoo-204	Core	Practical I	--	4+4	8	--	40	--	60	4
Zoo-205	Skill Based	Aquaculture & Ecology	4+4	--	8	40	--	60	--	4
Zoo AC-201 A/B/C/D	Audit Course	Choose one out of Four (AC-201A/ AC-201B/AC-201C/AC-201D) from Personality and Cultural Development	--	2	2	--	100	--	--	2
<b>Total Credit for Semester II: 22 (T = Theory: 12; P = Practical:4; Skill Based:4; Audit course:2)</b>										

**Semester III (wef Academic year 2022-23)**

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
Zoo-301	Core (Any one from A,B,C&D)	A)Animal Physiology I B)Reproductive Physiology I C)Entomology I D)Helminthology I	4	--	4	40	--	60	--	4
Zoo-302	Core	Enzymology and Immunology	4	--	4	40	--	60	--	4
Zoo-303	Core	Practical I	--	4+4	8	--	40	--	60	4
Zoo-304	Core	Practical II	--	4+4	8	--	40	--	60	4
Zoo-305	Elective (Select any one)	(A)Animal behaviour (B) Forensic Zoology (C) Endocrinology	4	--	4	40	--	60	--	4
Zoo AC-301 A/B/C/D	Audit Course	Choose one out of Four (AC-301A/ AC-301B/AC-301C/AC-301D) from Technology + Value Added Courses	--	2	2		100	--	--	2
<b>Total Credit for Semester III: 22 (T = Theory: 8; P = Practical: 8; Skill Based: 4; Audit Course: 2)</b>										

**Semester IV (wef Academic year 2022-23)**

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
Zoo-401	Core (Any one from A,B,C& D)	A) Animal Physiology II B) Reproductive Physiology II C) Entomology II D) Helminthology II	4	--	4	40	--	60	--	4
Zoo-402	Core	Molecular Biology	4	--	4	40	--	60	--	4
Zoo-403	Core	Practical I (corresponds to 401 and 402)	--	4+4	8	--	40	--	60	4
Zoo-404	Core	Project	--	4+4	8	--	40	--	60	4
Zoo-405	Elective (Select any one)	(A)Zoogeography (B)Writing & presenting scientific research paper (C)Computational Biology	4	--	4	40	--	60	--	4
Zoo AC-401 A/B/C/D	Audit Course	Choose one out of Four (AC-401A/ AC-401B/ AC-401C/ AC-401D) from Professional and Social + Value Added Courses	--	2	2		100	--	--	2
<b>Total Credit for Semester IV: 22 (T = Theory: 8; P = Practical: 8; Skill Based: 4; Audit Course: 2)</b>										

## MSc I Sem I Zoology 2021-21

<b>MSc I Sem I Core Courses</b>		
<b>Zoo - 101: Structure and Functional Anatomy of Invertebrates</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To understand the structural and functional anatomy of non-chordates.</li> <li>• To acquire the knowledge about locomotory, nutritional and organs of digestion and its mechanism</li> <li>• To understand the respiratory, excretory and nervous coordinating organization</li> <li>• To learn about the larval forms, colonial and social life of invertebrates.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• enlighten themselves with knowledge related to structural &amp; functional anatomy of invertebrate animals.</li> <li>• enrich themselves with understandings of organs and systems of locomotory, nutrition, digestion and other vital process.</li> <li>• know the larval forms found in invertebrates and their significance.</li> <li>• understand the social life in honey bees.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	A) Structural organization of invertebrates B) Diversity and phylogeny of invertebrate C) Organization of Coelom: i) Acoelomates, ii) Pseudocoelomates iii) Coelomates - Protostomia and Deuterostomia	<b>12</b>
<b>Unit II</b>	A) Locomotion: i) Locomotory organelles – Cilia, flagella ii) Flagella, Ciliary and amoeboid movement in protozoa B) Nutrition and Digestion: i) Pattern of feeding and digestion in lower metazoan, ii) Filter feeding in polychaeta, iii) Filter feeding and digestion in mollusca and deuterostoma	<b>12</b>
<b>Unit III</b>	Respiration: i) Organs of respiration- Gills and lophophores, ii) Gills and lungs in Mollusca, iii) Gills and trachea in Arthropoda, iv) Respiratory pigments in invertebrates. v) Mechanism of respiration in gastropoda and insecta.	<b>10</b>
<b>Unit IV</b>	A) Nervous system: i) Primitive nervous system- Coelenterates and Echinodermata, ii) Advanced nervous system- Annelida, Arthropoda	<b>14</b>

	(Crustacea and Insecta) and Mollusca (Cephalopoda). iii) Trends in neural evolution. B) Excretion and osmoregulation: i) Organs and Mechanism of excretion - Coelom, Coelomoducts, Nephridia and Malpighian tubules, ii) Osmoregulation in terrestrial and aquatic invertebrates.	
<b>Unit V</b>	A) Invertebrate larvae: i) Larval forms of Platyhelminthes, Crustacea, Mollusca and Echinodermata, ii) Significance of larval forms. B) Colonial and social life: i) Protozoan, Sponge and Coelenterate colonies ii) Social life in honey bee.	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Barnes R. O.: The Invertebrates, W. B. Saunders and Co.</li> <li>• Barrington E.J.W.: Invertebrates, Structure and function, homes Nelson and Sons, Ltd., London</li> <li>• Hyman L.H.: The Invertebrate Volume 1 to 8, McGraw Hill Co. New York</li> <li>• Jordan, E. L.: The Invertebrates, S. C. Chand, New Delhi.</li> <li>• Kotpal R. L.: Modern Text book of Zoology : Invertebrates, Rastogi publications, Meerut</li> <li>• Kotpal R.L.: Protozoa to Echinodermata Series,</li> <li>• Marshall and William : A text book of Zoology: Invertebrate Vol. I, CBS publishers, New Delhi.</li> <li>• Prasad S. N.: Life of Invertebrates, Vikas publishing house, New Delhi.</li> <li>• Russel Hunter : A Biology of higher invertebrates, McMillon Co. Ltd. London</li> </ul>	



<b>MSc I Sem I Core Courses</b>		
<b>Zoo - 102: Cellular organization and Developmental Biology</b>		
<b>Total Hours: 60</b>	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To understand the cellular organization with specific reference to plasma membrane, cell organelles and cell cycle.</li> <li>• To acquire the knowledge about basic concept of gametogenesis, fertilization and embryonic development.</li> <li>• To understand the concept of aging, apoptosis and senescence</li> <li>• To learn about the morphogenesis and organogenesis in specific animals.</li> </ul>	<b>Credits: 4</b>
	<p><b>Program specific outcomes</b></p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• Enrich themselves with the cellular organization with specific reference to plasma membrane, cell organelles and cell cycle.</li> <li>• acquire the knowledge about basic concept of gametogenesis, fertilization and embryonic development.</li> <li>• understand the concept of aging, apoptosis and senescence</li> <li>• know about the morphogenesis and organogenesis in specific animals.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<p>1. Structure and function of Plasma Membrane:</p> <p>a) Different models of Plasma Membrane</p> <p>b) Functions of Plasma Membrane –diffusion, osmosis, ion channels, active and passive transport, ion pumps</p> <p>2. Structural organization and function of intracellular organelles:</p> <p>a) Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum,</p> <p>b) Structure and function of cytoskeleton and its role in motility,</p> <p>c) Structure and function of filaments</p>	<b>12</b>
<b>Unit II</b>	<p>3. Cell cycle:</p> <p>a) Steps in cell cycle</p> <p>b) Regulation of cell cycle.</p> <p>4. Cell signaling:</p> <p>a) Signaling molecules – Hormones, neurotransmitters, second messengers.</p> <p>b) Types of signaling receptors - Extra cellular and intra cellular.</p> <p>c) Signal transduction pathways, signaling through G- protein coupled receptors, regulation of signaling pathways.</p>	<b>12</b>
<b>Unit III</b>	<p>Gametogenesis, fertilization and early development:</p> <p>a) Formation of gametes,</p> <p>b) Cell surface molecules in sperm-egg recognition in animals;</p> <p>c) Zygote formation, Cleavage, Blastulation, Gastrulation</p>	
<b>Unit IV</b>	<p>Basic concepts of development:</p> <p>a) Potency, commitment, specification, induction, competence, determination and differentiation;</p> <p>b) Morphogenetic gradients; cell fate and cell lineages;</p> <p>c) Stem cells; genomic equivalence and the cytoplasmic determinants; imprinting</p>	

	D)Aging, Apoptosis and Senescence	
<b>Unit V</b>	<p>Morphogenesis and Organogenesis in animals:</p> <p>a) Cell aggregation and differentiation in <i>Dictyostelium</i>;</p> <p>b) Axes and pattern formation in <i>Drosophila</i>, frog and chick;</p> <p>c) Organogenesis – vulva formation in <i>Caenorhabditis elegans</i>; eyelens induction, limb development and regeneration in <i>Planaria</i> and <i>Hemidactylus flaviviridis</i>.</p> <p>d) Differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.</p>	
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• De Roberts: Cell biology</li> <li>• Du Praw E.J.: Cell and Molecular biology</li> <li>• J. D. Watson: Molecular Biology of the gene</li> <li>• Prakash S. Lohar : Cell and Molecular Biology, MJP Publishers, Chennai</li> <li>• J. R. Baker: Cytological techniques</li> <li>• Gerald Karp: Cell and Molecular Biology, John Wiley and Sons International, London</li> <li>• Arumugum: Developmental Biology</li> <li>• Mourice: Animal growth and development</li> <li>• David R. Newth: Animal growth and development</li> <li>• Gilbert: Developmental Biology</li> <li>• B.M. Patten: Early embryology of Chick</li> <li>• B.M. Patten: Foundation of embryology</li> <li>• M. Sussaman: Animal growth and development</li> </ul>	

<b>MSc I Sem I Core Courses</b>		
<b>Zoo - 103: Practical I (corresponding to Zoo101)</b>		
<b>Lectures</b> 60	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To acquire the practical skill about dissection of Grasshopper or Cockroach related to their digestive, nervous and reproductive system.</li> <li>• To perform mountings of various significant parts of Grasshopper/Cockroach</li> <li>• understand the concept of systematics or taxonomic features of invertebrate animals.</li> </ul>	<b>Credits:</b> <b>4</b>
	<p><b>Program specific outcomes</b></p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• perform dissection of Grasshopper or Cockroach related to their digestive, nervous and reproductive system.</li> <li>• acquire practical skills for mountings of various significant parts of Grasshopper/Cockroach</li> <li>• Classify the invertebrate animals belonging to phylum Porifera to Hemichordata.</li> </ul>	<b>Lectures</b> 60
	<ol style="list-style-type: none"> <li>1. Dissection of Grasshopper/Cockroach so as to expose its – (E) <ol style="list-style-type: none"> <li>i. Digestive system</li> <li>ii. Nervous System</li> <li>iii. Reproductive system (Male and Female)</li> </ol> </li> <li>2. Mounting of following – (E) <ol style="list-style-type: none"> <li>i. Nephridia and Spermatheca of earthworm,</li> <li>ii. Mouthparts of Grasshopper/Cockroach,</li> <li>iii. Cornea and Wings of Grasshopper/Cockroach</li> <li>iv. Tracheal and spiracles of Grasshopper/Cockroach</li> <li>v. Ommatidium of Cockroach</li> </ol> </li> <li>3. Classification of Invertebrates - Porifera to Annelida up to order (one example from each order)</li> <li>4. Classification of Invertebrates -Arthropoda to Hemichordata up to order (one example from each order)</li> </ol>	

<b>MSc I Sem I Core Courses</b>		
<b>Zoo - 104: Practical II (corresponding to Zoo102)</b>		
<b>Total Hours: 60</b>	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To acquire knowledge about various cell organelles by studying their micro-photographs. .</li> <li>• To understand the principle PAS reaction.</li> <li>• To understand the process of preparation of mitotic spindle from cell material.</li> <li>• To learn technical skill to detect DNA and Protein in the given sample.</li> <li>• To acquire the skill related to detection of Mitochondria.</li> </ul>	<b>Credits: 4</b>
	<p><b>Program specific outcomes</b></p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• learn about various cell organelles by studying their micro-photographs. .</li> <li>• acquire the principle and protocol of PAS reaction.</li> <li>• gain the skill of preparation of mitotic spindle from cell material.</li> <li>• acquire technical skill to detect DNA and Protein in the given sample.</li> <li>• gain the skill related to detection of Mitochondria.</li> </ul>	
<b>Cellular organization</b>	<ol style="list-style-type: none"> <li>1. Study of electron microphotographs of various cell organelles.</li> <li>2. Preparation of mitotic Chromosomes from any suitable cell material.</li> <li>3. Detection of carbohydrates by PAS reaction.</li> <li>4. Detection of protein by bromophenol blue reaction.</li> <li>5. Detection of DNA by Feulgen reaction.</li> <li>6. Detection of Mitochondria by Janus green method</li> </ol>	
<b>Developmental Biology</b>	<ol style="list-style-type: none"> <li>1. Preparation of Permanent slide of Chick Embryo</li> <li>2. Study of different types of eggs – on the basis of amount of yolk, distribution of yolk, presence and absence of shell.</li> <li>3. Study of Cleavages- Snail, Amphioxus, fish, frog, birds and mammals</li> <li>4. Study of Blastulae- Amphioxus, frog and birds.</li> <li>5. Study of Gastrulae- Amphioxus, frog and birds.</li> <li>6. Study of types of placenta - Based on Distribution of villi on chorion, Histological types of placenta</li> </ol>	

<b>MSc I Sem I Skill Based Course</b>		
<b>Zoo - 105: Goatery</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>● To start Goat rearing as a small business enterprise by liaising with different stake holders</li> <li>● To manage Goat rearing effectively as a small business enterprise 5.</li> <li>● To gain all round knowledge of Goat rearing as a business enterprise rather than as a community profession</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>● understand, appreciate and develop the self-confidence for embarking on self-employment / entrepreneurship.</li> <li>● Understand various breeds of Goat, their characteristics and their adaptability.</li> <li>● gain the knowledge related to Goat rearing, to devise a simple marketing and sales strategies and plan for a small business.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	Professional Knowledge and Entrepreneurship <ol style="list-style-type: none"> <li>1. Knowledge of selfconfidence , attitude</li> <li>2. Entrepreneurial competencies</li> <li>3. Banking, insurance , financial accountancy and management</li> <li>4. Legal aspects ,regulatory aspects</li> </ol>	<b>10</b>
<b>Unit II</b>	Domain/Technical Knowledge <ol style="list-style-type: none"> <li>5. History of Goat breeding – practices , present scenario, prospects</li> <li>6. Various breeds of Goat, their characteristics, and their adaptability</li> <li>7. Up gradation of Goat breeds, recent introductions</li> <li>8. Housing in Goat rearing</li> <li>9. Common diseases in Goat, diagnosis and remedies</li> <li>10. Feed and Feeding</li> <li>11. Fodder and Fodder crops</li> <li>12. Systems of Goat rearing, management practices for lambrearing to produce healthy adults</li> </ol>	<b>20</b>
<b>Unit III</b>	Professional Skills <ol style="list-style-type: none"> <li>13. Engage in rearing of Goat</li> <li>14. Select appropriate breeds of Goat for the purpose</li> <li>15. Feed the Goat</li> <li>16. Manage the Pest and Diseases affecting Goat</li> <li>17. De-worming of Goat</li> <li>18. Collection of Samples of diseased Goat</li> <li>19. Build Goat Housing</li> </ol>	<b>15</b>

	20. Manage the young ones 21. Sheering of Goat	
<b>Unit IV</b>	Core Skills 22. Business Opportunity Identification 23. Market Survey and Business Plan Development 24. Planning and Risk Assessment 25. Problem solving 26. Time management 27. Communication 28. Business Management skills	<b>15</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Frank H. Baker and Mason E. Miller: Sheep And Goat Handbook, Vol. 4. CRC Press.</li> <li>• Mohan Chand Rajbar: Commercial Goat Farming in India- Guide: An entrepreneur manual to successful goat production and marketing in India Kindle Edition.</li> <li>• Board EiriHand Book of Goat Farming, Engineers India Research Institute.</li> <li>• Carol A. Amundson: How to Raise Goats: Third Edition, Everything You Need to Know. Atlantic Publishers and Distributors.</li> </ul>	

## MSc I Sem II Zoology 2021-21

MSc I Sem II Core Courses		
Zoo - 201: Structure and Functional Anatomy of Vertebrates		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To understand habit, habitat and taxonomic status of vertebrate animals.</li> <li>• To know the basic aspects of structural and functional anatomy of vertebrate animals.</li> <li>• To learn about adaptive radiation in vertebrates</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• gain the knowledge of the systematic position, habit and habitat of vertebrate animals</li> <li>• acquire the knowledge about structural and functional anatomy of vertebrates</li> <li>• understand distinguishing features between structure and function of vertebrates</li> </ul>	<b>Lectures</b> 60
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>A) Organization of Protochordates:</b> i) Urochordata with respect to <i>Salpa</i> : Morphology and Anatomy ii) Cephalochordata with respect to <i>Amphioxus</i> : Morphology and Anatomy <b>B) Origin and Phylogeny of Vertebrates:</b> <b>C) Cyclostomata:</b> Affinities and Phylogenetic status of Cyclostomata	<b>12</b>
<b>Unit II</b>	<b>Concept of Adaptive Radiation:</b> A) Fishes: Adaptive radiation in Chondrichthyes and Ostiochthyes B) Amphibia: Origin and evolution of Amphibia C) Reptilia: Evolution and adaptive radiation in Reptiles. D) Aves: i) Affinities of birds, ii) Origin and ancestry of birds, iii) Birds as glorified reptiles E) Mammals: i) Origin and ancestry of mammals, ii) Adaptive radiations in Prototheria, Metatheria and Eutherian Mammals.	<b>12</b>
<b>Unit III</b>	<b>Study of Endoskeleton of Human:</b> A) Axial Skeleton:	<b>12</b>

	<p>Skull, Vertebral Column, Rib Cage</p> <p>B) Appendicular Skeleton: Shoulder Girdle, Skeleton of Upper limb, Pelvic Girdle, Skeleton of Lower limb</p> <p>C) Functions of Human Skeleton.</p>	
<b>Unit IV</b>	<p>A) <b>Comparative account of Vertebrate Systems:</b></p> <p>i) Circulatory system</p> <p>ii) Urogenital system</p> <p>iii) Nervous system</p> <p>B) Neuro-endocrine interrelationship of Vertebrates</p>	<b>12</b>
<b>Unit V</b>	<p><b>Receptor organs in Vertebrates:</b></p> <p>Dogfish, Frog, Lizard, Pigeon, Rabbit:</p> <p>i) Olfactory</p> <p>ii) Gustatory</p> <p>iii) Photoreceptors (Eye)</p> <p>iv) Statoacoustic (Ear)</p>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Alexander, R. M.: The chordate. Cambridge University press London.</li> <li>• Ballairs: Reptiles (Hutchinson)</li> <li>• Bourne, G. M.: The structure and function of nervous tissue. Academic Press, New York.</li> <li>• Carter, G. S.: Structure and Habit in vertebrate evolutions. Sedgwich and Jackson, London.</li> <li>• Eccles, J. C.: The understanding of the brain. McGraw Hill Co., New York.</li> <li>• Green: Anatomy of Rat (Hafner)</li> <li>• Hyman: Comparative vertebrate Anatomy, University of Chicago Press.</li> <li>• Kingsley J. S.: Outlines of Comparative Anatomy of Vertebrates, Central book Depot, Allahabad.</li> </ul>	



<b>MSc I Sem II Core Courses</b>		
<b>Zoo - 202: Biochemistry</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know fundamental aspects of Biochemistry.</li> <li>• To study different biological reaction mechanism.</li> <li>• To know the importance of metabolism.</li> <li>• To study the biochemical molecules and their interactions</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• understand the basic terms related to biochemistry</li> <li>• illustrate the importance of pH, buffer and water in living systems</li> <li>• acquire the knowledge of structure and functions of various biomolecules and their interactions.</li> <li>• gain the facts about different forms of DNA, chemistry of hormones and vitamins.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>Basics of Biochemistry</b> <ol style="list-style-type: none"> <li>a) Covalent and Non-covalent bonds.</li> <li>b) Acids and bases: Proton donors and acceptors; strong/weak acids/bases; ionization of water and the ion product.</li> <li>c) pH scale and the physiological pH range; dissociation constant - <math>K_a</math> and <math>pK_a</math>;</li> <li>d) Henderson-Hasselbalch equation; buffer solutions; Normality and Molarity</li> </ol>	<b>12</b>
<b>Unit II</b>	<b>Chemistry of biomolecules and their significance:</b> <ol style="list-style-type: none"> <li>a) <b>Carbohydrates:</b> <ol style="list-style-type: none"> <li>i) Classification of carbohydrates;</li> <li>ii) Derivatives of monosaccharides: Phosphate esters, acids and lactones; amino sugars;</li> <li>iii) Oligosaccharides – Important disaccharides.</li> <li>iv) Polysaccharides: Storage and structural polysaccharides;</li> </ol> </li> <li>b) <b>Lipids:</b> Definition, classification, structure of fatty acids, triacylglycerols, phospholipids and sphingolipids, Steroid hormones; Lipids as constituents of biological membranes</li> <li>c) <b>Amino acids:</b> Structure, classification; non-protein amino acids, essential and non-essential amino acids; modified amino acids and function.</li> <li>d) <b>Nucleic acids:</b> Structure of bases, nucleosides and nucleotides; importance of nucleic acids.</li> </ol>	<b>12</b>
<b>Unit III</b>	<b>Protein Structure:</b> <ol style="list-style-type: none"> <li>a) Primary, secondary, tertiary and quaternary structures.</li> </ol>	<b>12</b>

	<p>b) Fibrous proteins and globular proteins- examples and biological significance.</p> <p>c) Conformation of protein - Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds.</p> <p>d) Stability of protein structures.</p>	
<b>Unit IV</b>	<p><b>Confirmation of Nucleic acids:</b></p> <p>a) A, B, Z-DNA, b) t-RNA, c) micro-RNA.</p> <p><b>Chemistry of Hormones:</b></p> <p>a) Types: Amine, peptide and steroids. b) Properties of hormones. c) Mode of action of peptide and steroid hormones.</p>	<b>12</b>
<b>Unit V</b>	<p><b>Vitamins (Structural formula not expected):</b></p> <p>a) Definition, Classifications: Fat and Water soluble vitamins. b) Fat soluble vitamins: A, D, E and K with respect to sources and daily requirements. c) Water soluble vitamins: B complex (B1, B2, B6 and B12) with respect to sources and daily requirements. d) Principle role in metabolism and Deficiency diseases.</p>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Biochemical Calculations: Segel Irvin H., Publisher: John Wiley and Sons, New York, 2nd Ed., (1997).</li> <li>• Biochemistry: Berg Jeremy, Tymoczko John, Stryer Lubert, Publisher: W. H. Freeman, New York, 6th Ed, (2007).</li> <li>• Biochemistry: Geoffrey Zubay, William C Brown Pub; 4th edition (June 1999)</li> <li>• Biochemistry: Satyanarayan</li> <li>• Biochemistry: Stryer</li> <li>• Biochemistry: Voet Donald and Voet Judith G. John, Publisher: Wiley and Sons, New York, 3rd Ed. (2005).</li> <li>• Enzymes, Biochemistry, Biotechnology and Clinical chemistry: Palmer Trevor, Publisher: Horwood Pub. Co., England, (2001).</li> <li>• Harper's Biochemistry: Robert Murray, D. K. Granner, Peter A. Mayer and Victor W. Rodwell, International 25th edition.</li> <li>• Lehninger's Principles of Biochemistry: Nelson D. L. and Cox M. M. W. H. Freeman &amp; Co. NY, 4th edition, (2005).</li> <li>• Principles and techniques of practical Biochemistry: K. Wilson and J. Walkar, ISBN edition</li> </ul>	

<b>MSc I Sem II Core Courses</b>		
<b>Zoo - 203: Tools and Techniques in Biology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know basic terms of biological techniques.</li> <li>• To study the applications of the various biological techniques.</li> <li>• To know the principle, working and applications of basic techniques used in biology.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• explain the importance and applications of biological techniques.</li> <li>• illustrate the principle, working, materials used and applications of various biological techniques.</li> <li>• gain the knowledge related to radio activity and immunological techniques.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>Principle, parts and applications of Microscopic Techniques:</b> <ol style="list-style-type: none"> <li>i) <b>Mircroscope:</b> Light, phase contrast, interference, fluorescence, polarization,</li> <li>ii) Inverted and electron microscopy.</li> </ol> <b>Principles and applications of Instruments:</b> <ol style="list-style-type: none"> <li>i) UV-Vis spectrometry</li> <li>ii) Colorimeter</li> <li>iii) Fluorimeter</li> </ol>	<b>12</b>
<b>Unit II</b>	<b>Principles and Uses of analytical instruments:</b> <ol style="list-style-type: none"> <li>i) Balances, pH meter,</li> <li>ii) Densitometric scanner, chemiluminometer.</li> <li>iii) Radioactivity counter, Differential scanning calorimeter.</li> <li>iv) ESR and NMR spectrometers.</li> </ol>	<b>12</b>
<b>Unit III</b>	<b>Cell culture Techniques:</b> <ol style="list-style-type: none"> <li>i) Design and functioning of tissue culture laboratory</li> <li>ii) Cell proliferation measurement</li> <li>iii) Cell viability testing</li> <li>iv) Culture media preparation and cell harvesting methods</li> </ol>	<b>12</b>
<b>Unit IV</b>	<b>Separation Techniques:</b> <ol style="list-style-type: none"> <li>i) <b>Centrifugation techniques:</b> Principles and working of centrifuge, RPM, rotors and its types, types of centrifuge (high speed centrifuge, ultra - centrifuge and gradient centrifuge)</li> <li>ii) <b>Chromatographic techniques:</b> Basic principles of chromatography, Rf value calculation, adsorption, absorption, solvents and solutes</li> <li>iii) Paper chromatography, column chromatography, gel filtration, ion exchange chromatography, HPLC, gas chromatography.</li> </ol>	<b>12</b>

	<p>iv) <b>Electrophoresis:</b> Gel electrophoresis (one and two dimensional) SDS-PAGE, AGAROSE. Various methods and agents used in detection of bands.</p> <p>v) <b>Blotting techniques:</b> Southern blotting, northern blotting, and western blotting, south western blotting.</p>	
<b>Unit V</b>	<p><b>Radio Activity and Immunological techniques</b></p> <p>i) Radio labeling and radioactive techniques</p> <p>ii) Properties of different types of radioisotopes in biological system, radio degradation, half-life period, auto radiography, safety guidance.</p> <p>iii) Rocket immune-electrophoresis and Ouchterlony double diffusion method</p> <p>iv) Biosensors</p>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Bullock, J. D., Kristiansen, B.: Basic Biotechnology, 1987, Academic press, New York.</li> <li>• D. B. Tembhare: Techniques in Life Sciences, Himalaya Publishing House.</li> <li>• Keith Wilson, John Walker: Principles and Techniques of Practical Biochemistry</li> <li>• Keshav Trehan: Biotechnology. Wiley Eastern Limited, Bangalore, 1990.</li> <li>• Plummer, L: Practical Biochemistry Tata McGraw-Hill.</li> <li>• Prave, P. Faust, V., Sitting, W and Sukatsch, D.A.: Fundamental of Biotechnology, VCL Publishers, New York. 1987.</li> <li>• Spier, R. E. and Griffins, J.B.: Animal Cell Biotechnology, Vol. I&amp;II, Academic Press, Orlande, 1985.</li> <li>• T. Poddar, S. Mukhopadhyay, S. K. Das: An Advanced Laboratory Manual of Zoology, MacMillan.</li> <li>• Wilson: Principles and Techniques of Practical Biochemistry</li> </ul>	

<b>MSc I Sem II Core Courses</b>		
<b>Zoo - 204: Practical I (corresponding to Zoo 201 + 202 + 203)</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know anatomy and physiology of vertebrate animals.</li> <li>• Analysis of tissues / cells with reference to DNA, RNA, Protein, vitamins, etc.</li> <li>• To know biochemical processes their reactions and role in life.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• acquire the knowledge related to characters, classification, anatomy and physiology of vertebrates.</li> <li>• gain the knowledge related to principle, class, structure and functions of various biomolecules.</li> <li>• .understand the tools and techniques used in biology.</li> </ul>	
<b>Unit</b>		
	<b>Structural and Functional Anatomy of Vertebrates</b>	
	<ul style="list-style-type: none"> <li>• Classification of Vertebrates - Urochordata to Amphibia up to order (one example from each order)</li> <li>• Classification of Invertebrates - Reptilia to Mammalia up to order (one example from each order)</li> <li>• Study of Axial and Appendicular skeleton of Rabbit.</li> <li>• Study of eye ball muscles of Scoliodon / Pecten from eye ball of hen.</li> <li>• Comparative study of Heart of Frog, Calotes, Pigeon, Rat.</li> <li>• Comparative study of Brain of Frog, Calotes, Pigeon, Rat.</li> </ul>	
	<b>Biochemistry</b>	
	<ul style="list-style-type: none"> <li>• Preparation of buffer of given molarity and pH.</li> <li>• Determination of pKa value of glycine.</li> <li>• Determination of protein by Barford reaction</li> <li>• Estimation of Nucleic acid, DNA / RNA.</li> <li>• Estimation of Vitamin 'C' from suitable source.</li> </ul>	
	<b>Tools and Techniques in Biology</b>	
	<ul style="list-style-type: none"> <li>• Calibration of pH meter.</li> <li>• Study of Compound and Phase Contrast microscopy.</li> <li>• To verify Beer-Lamberts Law.</li> <li>• Cell fractionation by using density gradient centrifuge (any suitable gradient)</li> <li>• Test Cell viability and Counting.</li> <li>• Determination of Molecular Weight of DNA by electrophoresis</li> <li>• Study of agglutination reaction and its significance performing WIDAL test.</li> </ul>	

<b>MSc I Sem II Skill Based Course</b>		
<b>Zoo - 205: Aquaculture and Ecology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know the differentiating ability of abiotic and biotic components of ecosystem, interactions of various factors of ecosystem.</li> <li>• To know the various biodiversity, hotspot and conservation of ecosystems.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• acquire skills of analysis of abiotic and biotic factors present in environment and their interactions for various associations.</li> <li>• understanding various biodiversity, hotspot and conservation of ecosystems.</li> </ul>	
	<b>Aquaculture</b>	
	<ul style="list-style-type: none"> <li>• <b>Aquaculture:</b> Concept and its scope; Nutritional value of fish</li> <li>• <b>Physicochemical parameter of water for fish culture:</b> pH, Calcium, Total Alkalinity, Nitrate, Ammonia, Total hardness of fresh water</li> <li>• <b>Construction and Management of Fish culture pond:</b> Construction of ponds, management of ponds, Predatory and weed fishes and their control, Aquatic weeds and their control, Aquatic insects and their control, fish feeding: natural and artificial.</li> <li>• <b>Fish breeding:</b> Natural and Induced Natural breeding in pond water, Induced breeding- Pituitary extract, selection of breeders, injection of pituitary extract, spawning, Advantages of induced breeding.</li> <li>• <b>Transport of fish seed and Brood fish:</b> Causes of mortality in transport, methods for packaging and transport, open systems, closed systems, use of chemicals in live fish transport, anesthetic drugs, antiseptics and antibiotics.</li> <li>• <b>Fish Culture:</b> Selection of cultivable fish, monoculture, composite culture, culture of Indian major carps, Culture of common carps, culture of cat fishes, paddy cum fish culture, mari culture, cage culture, integrated fish farming</li> <li>• Fish preservation, processing and byproducts Fish preservation techniques, fish byproducts</li> <li>• <b>Fish pathology:</b> Bacterial, fungal, protozoan and worm diseases of fish.</li> <li>• <b>Technologies in Fisheries Development:</b> Geographic Information System (GIS) technology, Use of Information Communication Technology (ICT) in fishes: production</li> </ul>	<b>30</b>

	aspects, marketing aspects.	
	<b>Ecology</b>	
	<ul style="list-style-type: none"> <li>• <b>Introduction:</b> The Environment: Physical and Biotic environment; Biotic and Abiotic Interactions.</li> <li>• <b>Population Ecology:</b> Characteristics of a population; population growth curves; population regulation; life history strategies (<i>r</i> and <i>K</i> selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations.</li> <li>• <b>Species Interactions:</b> Types of interactions, interspecific competition, herbivore, carnivore, symbiosis. Levels of species diversity and its measurement.</li> <li>• <b>Ecological Succession:</b> Types; mechanisms; changes involved in succession; concept of climax.</li> <li>• <b>Ecosystem:</b> Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).</li> <li>• <b>Applied Ecology:</b> Environmental pollution; Global environmental change; Biodiversity- Concept, Patterns, Importance; Biodiversity Hotspots; Status, Monitoring and documentation; Major drivers of biodiversity change; Biodiversity management approaches.</li> <li>• <b>Conservation Biology:</b> Principles of conservation, Major approaches to management, Indian case studies on conservation / management strategy (Project Tiger, Biosphere reserves).</li> </ul>	<b>30</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Bailey, N.T.J (1959): Statistical methods in Biology, ELBS and The English Universities Press Ltd. UK.</li> <li>• Khanna S.S.: An Introduction to fishes, Central Book Depot, Allahabad.</li> <li>• Sharma P.D.: Ecology, Rastogi publication, Meerut.</li> <li>• Talwar P.K. and A.G. Jhingran: Inland fishes Vol. I and II, Oxford and IBM Publishing Co. Pvt. Ltd.</li> <li>• Trivedi R. K., Goel P. K., Trisal C. L.: Practical methods in Ecology and Environmental Science Environmental Publishers, Karad.</li> </ul>	

## MSc II Sem III Zoology (wef Academic year 2022-23)

MSc II Sem III Core Courses		
Zoo- 301: (A) Animal Physiology – II		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To learn about the various aspects of Animal physiology.</li> <li>• To acquire a broad understanding of physiological processes.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> <ul style="list-style-type: none"> <li>• To understand the structure and functioning of Animal physiology</li> <li>• To gain the detail knowledge on Animal physiology</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>A)Defination, significance and scopes of physiology</b> <b>B)Water Relation and Ionic Regulation</b> i) Role of membranes in osmotic and ionic regulation; Role of body fluid; ii) Adaptation to marine habitat; Adaptation to brackish water habitat; Adaptation to Fresh water habitat; Adaptation to terrestrial habitat <b>C) Thermoregulation:</b> i)Homeostasis; ii)Classification of Animals Based on Thermoregulation; iii)Vants Hoff law; Lethal temperature; iv)Effect of cold Acclimation; v)Thermoregulatory Mechanisms; Vi)Thermoregulation in Camel.	<b>15</b>
<b>Unit II</b>	<b>Metabolism</b> a) <b>Carbohydrate Metabolism:</b> Intermediary Metabolism; Glycogenesis; Glycogenolysis; Glycolysis, Krebs cycle,Electron transport system; Respiratory chain; Oxidativephosphorylation; Energetics of Glucose; Metabolism;Pasteur effect; Gluconeogenesis; Cori cycle or lactic acidcycle; Uronic acid pathway; Crabtree effect, b) <b>Lipid metabolism:</b> Metabolism of lipids; Oxidation ofGlycerols; Fatty Acid, Oxidation; $\beta$ -Oxidation;Ketogenesis; Ketosis; Ketolysis; Biosynthesis of FattyAcids; Biosynthesis of Triglycerides, c) <b>Protein Metabolism:</b> Deamination; Transamination; Decarboxylation; Ornithine cycle; Krebs Cycle, Citric Acid Cycle; Catabolism of the Carbon; Skeleton of amino acids; Pyruvic acid; Amino acids entering by $\alpha$ -Ketoglutaric Acid; Amino Acids entering by Succinyl Co-enzyme A; Catabolism of Amino Acids that are both Ketogenic and Glucogenic; Anabolism of Proteins; Energetics of amino Acids Oxidation.	<b>15</b>
<b>Unit III</b>	<b>Nutrition and Digestive system</b> a) Types of nutrition; Ingestion; Feeding mechanism; Digestion; Enzymes; b) Physiology of digestion; Absorption; Assimilation; Egestion or defaecation, c) The evolution of digestive mechanism: Phagocytosis; A	<b>10</b>



	digestive cavity (Intracellular digestion), d) Organization of Vertebrate Digestive System, e) Functional Adaptations of the Alimentary Canal, f) Types of Digestion.	
<b>Unit IV</b>	<b>Respiration</b> a) Introduction; b) Mechanism of respiration in man; c) Tidal volume and Vital capacity; d) Control of respiration; e) Respiratory pigments: a) Hemoglobin, b)Haemocyanin, c) Haemoerythrin, d) Chlorocruorin, e) Molpadin, f) Pinnaglobin, g) Vanadium, h) Echinochrome f) Haemoglobin as an Oxygen Carrier; Transport of Gases- Oxygen transport: Oxygen, Dissociation Curve; Bohr's effect; Chloride shift;Respiratory Quotient; g)Anaerobiosis	<b>10</b>
<b>Unit V</b>	<b>Circulatory system</b> a) Introduction; Functions of Circulatory system in Vertebrates; Closed and open Circulatory system; b) Types of Circulation: a)Systemic circulation b)Pulmonary circulation, c)Advantages of Double Circulation; c) Types of Heart: Pulsating Heart, Tubular Heart, Chambered Heart, Accessory heart d) Physiological types of Hearts: Neurogenic heart and Myogenic heart, e) ECG; Heart Sound; Cardiac cycle; Cardiac output; f) General plans of Circulation: Annelid plan, Amphioxus plan, Gill plan of fishes, Lung plan of Mammals; g) Blood vessels: i) Arteries and arterioles ii)Veins and Venules, iii)Microcirculation	<b>15</b>
	<b>Total</b>	<b>60</b>
<b>Suggested Readings</b>	G. J. Tortora: Principle of Anatomy and Physiology • Hoar: General and Comparative physiology • Dr. P.V. Jabade: General Physiology • B. K. Berry: Animal Physiology • C. C. Chatterjee: Human Physiology • Goel and Shastri: Textbook of Animal Physiology • K.S. Nelson: Animal Physiology • Holurn: Principles of Physiology and Biochemistry • Bell and Davidson: Textbook of Physiology and Biochemistry • Withers: Comparative Animal Physiology • Mohan P. Arora: Animal Physiology R. C. Sobti; Animal Physiology	

<b>MSc I Sem II Core Courses</b>		
<b>Zoo -303: Practical I Corresponding to Zoo 301 (A) Animal Physiology I</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know process of preparation of buffers and saline</li> <li>• To estimate SGOT and SGPT and analyse vital functions</li> <li>• To understand process of estimating biochemicals</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• acquire the knowledge related to process of preparation of buffers and saline</li> <li>• gain the knowledge related to estimation of SGOT and SGTP</li> <li>• learn the process of estimations of various biochemicals</li> </ul>	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Preparation of Phosphate and Bicarbonate Buffers, given Normality solutions, Physiological Mammalian Saline Solution.</li> <li>2. To demonstrate the principle of Osmosis.</li> <li>3. Estimation of SGOT/SGPT from given biological sample.</li> <li>4. Study of adaption in brackish, Fresh, marine water and terrestrial habitat.</li> <li>5. Determination of oxygen consumption of any suitable animal.</li> <li>6. Determination of Salivary Enzyme digestion and Effect of Temperature on Enzyme Activity.</li> <li>7. Recording of lung volumes and capacities by spirometry.</li> <li>8. Determination of Fatty acids and Amino Acid from Lipid and Protein Digestion respectively.</li> <li>9. Antioxidant activity of any suitable material.</li> <li>10. Estimation of plasma proteins by copper sulphate specific gravity method.</li> <li>11. Estimation of Blood Glucose level.</li> </ol>	

<b>MSc II Sem III Core Courses</b>		
<b>Zoo – 301 (B): Reproductive Physiology-I</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To learn about the various aspects of reproductive physiology.</li> <li>• To acquire a broad understanding of the hormonal regulation of physiological processes.</li> <li>• To build reproductively healthy society by providing proper knowledge related to reproductive aspects.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• Understand the structure of male and female reproductive systems particularly in humans.</li> <li>• Understand the functioning of male and female reproductive systems particularly in humans.</li> <li>• Comprehension of the interplay of various hormones in the functioning and regulation of the male and female reproductive systems.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>Male Reproductive System :</b> <ul style="list-style-type: none"> <li>• Internal and External Genitalia</li> <li>• Histological structure and functions of testis</li> <li>• Male accessory ducts and accessory reproductive organs:- Epididymis, Seminal vesicle, Prostate gland, Bulbourethral gland</li> <li>• Cryptorchidism</li> <li>• Semen</li> </ul>	<b>14</b>
<b>Unit II</b>	<b>Female reproductive System:</b> <ul style="list-style-type: none"> <li>• Internal and External Genitalia</li> <li>• Histological structure and functions of:- ovary ,Graafian follicle corpus luteum and corpus albicans</li> <li>• Structure and functions of:- Fallopian tube ,Uterus</li> <li>• Structure and functions of:- Bartholin’s gland, Mammary glands</li> </ul>	<b>14</b>
<b>Unit III</b>	<b>Gametogenesis-</b> <ul style="list-style-type: none"> <li>• Structure of sperm</li> <li>• Spermatogenesis , Spermiogenesis,, Maturation and storage of sperm, Motility, capacitation and fate of spermatozoa.</li> <li>• Structure of ovum</li> <li>• Oogenesis , Ovulation, Gametogenesis at the chromosomal level: mitosis and meiosis</li> </ul>	<b>14</b>
<b>Unit IV</b>	<b>Reproductive cycles-</b> <ul style="list-style-type: none"> <li>• Estrous and menstrual cycles</li> <li>• Hormonal control of normal menstrual cycle</li> <li>• Puberty and delayed puberty , menarche and menopause</li> </ul>	<b>10</b>
<b>Unit V</b>	<b>Chemistry, biosynthesis, mode of action and functions of Sex hormones and Gonadotropins</b> <ul style="list-style-type: none"> <li>• Male Sex hormones :- androgen</li> <li>• Female sex hormones:- oestrogens and progesterone</li> <li>• Hormones of pituitary gland:- FSH, LH</li> </ul>	<b>08</b>

<p><b>Suggested Readings</b></p>	<ul style="list-style-type: none"> <li>• Prakash S Lohar, 2012 – Endocrinology Hormones and Human Health, MJP Publishers, Chennai</li> <li>• P. J. Hogarth, 1978- Biology of Reproduction Wiley, New York.</li> <li>• J. S. Perry, 1971- The Ovarian cycle of animals, Oliver and Boyed.</li> <li>• C.R. Austin and R. V. Short, 1972 Reproduction in Mammals, Vol. 1-8, Cam. Uni. Press.</li> <li>• P. Gibian and E.J. Platz, eds, 1970- Mammalian Reproduction, Springer Verlag.</li> <li>• Robert H. Williams, 1981 – Text book of Endocrinology, W. B. Saunders Company</li> <li>• Chandi Charan Chatterjee, 1985 – Human Physiology Vol.II Tenth Edition, Medical Allied Agency, Calcutta, India.</li> <li>• Arthur J. Vander, James H. Sherman and Dorothy S. Luciano – Human Physiology,</li> <li>• Mcgraw-Hill International Editions, Biological Sciences Series.</li> <li>• Nalbandov, A. V.- Reproduction Physiology.</li> </ul>	
----------------------------------	---	--

**MSc I Sem II Core Courses**

**Zoo - 303:Practical corresponding to ZOO 301 (B) Reproductive Physiology - I**

<p><b>Total Hours: 60</b></p>	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To demonstrate endocrine glands and their physiological role</li> <li>• To study different stages of reproductive cycle</li> <li>• To understand histology of organs of reproduction</li> </ul>	<p><b>Credits: 4</b></p>
	<p><b>Program specific outcomes</b> After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• acquire the knowledge related to endocrine glands</li> <li>• gain the knowledge related to reproductive cycle</li> <li>• understand the histology of organs related to reproductive system</li> </ul>	
<p><b>Practical</b></p>	<ul style="list-style-type: none"> <li>• Demonstration of rat/mice endocrine glands with the help of figure/chart/model.</li> <li>• Histological structure of male and female reproductive organs in rat/mice/human.</li> <li>• Study of different stages of estrous cycle.</li> <li>• Microscopic observations of spermatozoa / ova from suitable mammal</li> <li>• Histological structure of male accessory reproductive organs.</li> <li>• Histological structure of female accessory reproductive organs.</li> <li>• Cellular structure of anterior pituitary gland.</li> </ul>	

<b>MSc II Sem III Core Courses</b>		
<b>Zoo - 301: (C) Entomology I</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To understand habit, habitat and taxonomic status of vertebrate animals.</li> <li>• To know the basic aspects of structural and functional anatomy of vertebrate animals.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• Acquire the knowledge of entomology and insects and understand origin and evolution of insects and their relation to other arthropods.</li> <li>• Understand the classification of insects up to family with distinguishing characters and examples of each order and family.</li> <li>• Understand the structure, chemical composition and functions of Integument and its derivatives, modifications of insect body regions and their appendages.</li> <li>• Acquire the knowledge of comparative anatomical and histological structure of various body systems.</li> <li>• Understand the location, structure and functions of various Endocrine and Exocrine glands, Light and Sound producing organs in various insects.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	General outline of Classification and Phylogeny of insects. Classification of following insect orders up to families A) Apterygota: Thysanura, Collembolla	<b>12</b>
<b>Unit II</b>	B) Pterygota: <ul style="list-style-type: none"> <li>a) Odonata</li> <li>b) Orthoptera – Tettigonidae, Gryllotalpidae, Acrididae</li> <li>c) Dytioptera- Blattidae, Mantidae</li> <li>d) Isoptera</li> <li>e) Mallophaga</li> <li>f) Siphanunculata</li> <li>g) Hemiptera:               <ul style="list-style-type: none"> <li>• Suborder- Homoptera - Flugoridae, Cicadidae, Aphididae</li> <li>• Suborder- Heteroptera – Cimiadae, Pyrochoridae, Pentatomidae, Belostomidae</li> </ul> </li> </ul>	<b>12</b>
<b>Unit III</b>	h) Coleoptera: <ul style="list-style-type: none"> <li>• Suborder- Adephaga- Carabidae, Dysticidae</li> <li>• Suborder- Polyphaga- Hydrophilidae, Scarabidae, Bupristidae, Tenebrionidae, Curcurlionidae</li> </ul> i) Diptera: <ul style="list-style-type: none"> <li>• Suborder- Nematocera- Culicidae, Chironomidae</li> <li>• Suborder- Brachaeocera- Tabanidae</li> </ul>	<b>12</b>

	<ul style="list-style-type: none"> <li>• Suborder- Cyclorrhapha- Syrphidae, Muscidae, Hippoboscidae, Glossinidae</li> <li>j) Lepidoptera: Nymphalidae, Papilionidae, Sphingidae, Noctuidae</li> <li>k) Hymenoptera: <ul style="list-style-type: none"> <li>• Symphyta- Tenthredinidae</li> <li>• Apocrita- Apidae, Ichneumonidae</li> </ul> </li> </ul>	
<b>Unit IV</b>	<p>A) Integument and its derivatives</p> <p>B) Comparative study of –</p> <ul style="list-style-type: none"> <li>• Head and its appendages</li> <li>• Thorax and its appendages and</li> <li>• Abdomen and its appendages</li> </ul>	<b>12</b>
<b>Unit V</b>	<p>A) Comparative anatomical and histological study of the following:</p> <ul style="list-style-type: none"> <li>• Alimentary canal and associated glands</li> <li>• Circulatory system</li> <li>• Ventilatory system</li> <li>• Excretory system and fat bodies</li> <li>• Nervous system and sense organs</li> <li>• Reproductive system</li> </ul> <p>B) Light and sound producing organs</p>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Chapman R. F.: The Insect: Structure and Function, E.L.B.S., and E.U.P. London.</li> <li>• Comstock J. H.: An Introduction to Entomology, Ithaca, New York.</li> <li>• Fox R. M and J. W. Fox: Introduction to comparative Entomology, Reinhold, New York.</li> <li>• Mani M. S.: General Entomology, 2nd edition, Oxford and IBH Publishing Company, New Delhi.</li> <li>• Nayar K. K., T. N. Anathakrishnan and B.V. David: General and Applied Entomology, Tata McGraw-Hill, New Delhi.</li> <li>• Richards O. W. and R. G. Davies: Imm's text book of entomology, Methuen and com, London, Vol. I and II</li> <li>• Ross H. H.: A Text book of Entomology, John Wiley and Sons, Ins. New York.</li> <li>• Snodgrass R. E.: Principles of insect morphology, Tata McGraw Hill Bombay.</li> <li>• Tembhare D. B.: Modern Entomology, 2<sup>nd</sup> edition, Himalaya Publication House, Bombay.</li> </ul>	

<b>MSc II Sem III Core Courses</b>		
<b>Zoo - 304: Practical I (corresponding to Zoo 301(C) Entomology I)</b>		
<b>Total Hours: 60</b>	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To know the knowledge of entomology and insects and understand origin and evolution of insects and their relation to other arthropods.</li> <li>• Understand the outline of classification of insects up to family with distinguishing characters and examples of each order and family.</li> <li>• To know the location, structure and functions of various endocrine and exocrine glands, light and sound producing organs in various insects.</li> </ul>	<b>Credits: 4</b>
	<p><b>Program specific outcomes</b> After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• Acquire the knowledge of entomology and insects and understand origin and evolution of insects and their relation to other arthropods.</li> <li>• Give outline of classification of insects up to family with distinguishing characters and examples of each order and family.</li> <li>• Understand the structure, chemical composition and functions of Integument and its derivatives, modifications of insect body regions and their appendages.</li> <li>• Understand the location, structure and functions of various endocrine and exocrine glands, light and sound producing organs in various insects.</li> </ul>	
<b>Unit</b>	<b>Zoo 301(C) Entomology I</b>	
	<ul style="list-style-type: none"> <li>• Collection and preservation techniques of insects</li> <li>• Classification of insects upto orders and families as per syllabus</li> <li>• Pictorial Collection and Identification of 25 insect species related to different orders and families</li> <li>• Culturing/rearing of any suitable insect/s (Housefly/ Drosophila)</li> <li>• Histology of Integument and its derivatives with the help of Slides (D)</li> <li>• Comparative study of Head capsule – any four (adults or larvae) from local area</li> <li>• Temporary preparation of Insects, <ul style="list-style-type: none"> <li>• Mouthparts, Antennae, Legs, Wings and Genitalia.</li> <li>• Halter of Housefly</li> </ul> </li> <li>• Study of Bugs, Beetles, House Fly with reference to following systems (Any 2 insects) <ul style="list-style-type: none"> <li>• Digestive system</li> </ul> </li> </ul>	



	<ul style="list-style-type: none"> <li>• Reproductive system</li> <li>• Nervous system</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Histology of different organs of – <ul style="list-style-type: none"> <li>• Alimentary canal,</li> <li>• Trachea,</li> <li>• Heart,</li> <li>• Muscle,</li> <li>• Blood of suitable insects</li> </ul> </li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Compulsory visit to Agriculture College or University or Research institute.</li> </ul>	
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Chapman R. F.: The Insect: Structure and Function, E.L.B.S., and E.U.P. London.</li> <li>• Comstock J. H.: An Introduction to Entomology, Ithaca, New York.</li> <li>• Fox R. M and J. W. Fox: Introduction to comparative Entomology, Reinhold, New York.</li> <li>• Mani M. S.: General Entomology, 2nd edition, Oxford and IBH Publishing Company, New Delhi.</li> <li>• Nayar K. K., T.N. Anathakrishnan and B.V. David: General and Applied Entomology, Tata McGraw-Hill, New Delhi.</li> <li>• Richards O. W. and R. G. Davies: Imm's text book of entomology, Methuen and com, London, Vol. I and II</li> <li>• Ross H. H.: A Text book of Entomology, John Wiley and Sons, Ins. New York.</li> <li>• Snodgrass R. E.: Principles of insect morphology, Tata McGraw Hill Bombay.</li> <li>• Tembhare D. B.: Modern Entomology, 2<sup>nd</sup> edition, Himalaya Publication House, Bombay.</li> </ul>	

<b>M. Sc. II: Semester III Core Courses</b>		
<b>Zoo 301 (D) Helminthology-1</b>		
Total Hours: 60	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• The programme has been designed in such a way so that the students get the flavour of both classical and modern aspects of Zoology/Animal Sciences.</li> <li>• It aims to enable the students to study Heminthology-1 as a core course.</li> <li>• The lab courses have been designed in such a way that students will be trained to join public or private labs.</li> </ul>	Credits: 4
	<b>Program specific outcomes</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the Parasitology and Heminthology.</li> <li>• Know about the classification of Helminthes.</li> <li>• To be familiar with the life cycle of various parasites</li> <li>• Students learn about the Nature, pathogenicity and prevention of endoparasites.</li> <li>• Their identification, nature of damage control of these endoparasites.</li> </ul>	Lectures 60
Unit	Topics	
<b>Unit 1</b>	1. Introduction to Parasitology and scope of Helminthology 2. Origin and evolution of parasites. 3. Inter-specific biological relationships , symbiosis, Commensalisms and parasitism. 4. Adaptation in parasites. 5. Types of Parasites. 6. Types of hosts- Definitive and intermediate, primary, secondary specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental, Vectors etc.	12
<b>Unit 2</b>	1. General organization and Classification of Platyhelminthes up to order level. Cestodes (Cestodarians and Eucestodes), Trematodes (Monogenea, Aspidobothria and Digenea) 2. Functional anatomy of Reproductive system a. Trematodes (Digeneans) b. Cestodes (Pseudophyllideans & Cyclophyllideans). 3. Types of Cercaria. 4. Different types of larvae in cestodes and their pathogenicity. 5. Holdfast organs with its adaptations in cestodes	14
<b>Unit 3</b>	1. Life cycle patterns of Digenetic Trematodes a) Single intermediate host life cycle. b) Two intermediate host life cycles 2. Life cycle patterns in Cestodes a) No intermediate host life cycle b) Single intermediate host life cycle c) Two intermediate host life cycles.	12
<b>Unit 4</b>	Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment & prevention of the following Trematodes 1. <i>Pragonimus westermani</i> 2. <i>Fasciolopsis buski</i> 3. <i>Gastrodiccoides hominis</i> .	10

<b>Unit 5</b>	Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention of the following Cestodes: <i>1) Diphyhidium canium</i> 2) <i>Diphyllobothrium latum</i> 3) <i>Echinococcous granulosus</i> 4) <i>Taenia saginata</i> 5) <i>Hymenolepis nana</i>	12
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Medical Parasitology by Markell, Voge and John, 8thed. W.B. Saunders Co.</li> <li>• The Biology of animal parasites, Cheng T.C. (1964)-Saunders International Student Edition.</li> <li>• The advances in the Zoology of tapeworm from 1970- Wardle and Mcleod</li> <li>• Text book Medical Parasitology Jaypee Brothers, - Medical Publishers, New York. - Panikar C.K.J (1988)</li> <li>• The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977)</li> <li>• Parasitology (Protozoology and Helminthology) –Sood Pamnik (1993) CBS Publication and Distrubution, Delhi.</li> <li>• Human helmintology Manual for Clinical, Sanitararians Medical Zoologists – Faust, Emerest Caroll.</li> <li>• Systema Helminthum Vol. II Cestoda - Yamaguti S. (1963) Inter-Science Publishers, London.</li> <li>• Synopsis of Digenetic Trematodes of Vertebrates – Yamaguti S. (1971) Vol. I &amp; II Keigaku Publishing Co., Tokyo, Japan.</li> <li>• Keys to the Cestode Parasites of Vertebrates, CBA</li> <li>• International - Khalil, Jones and Bray (1994)</li> <li>• Cestodes Parasites of Indian Mammals - Nama (1990)</li> </ul>	

**MSc I Sem II Core Courses**

**Zoo - 303: Practical I Practical corresponding to ZOO 301 (D) Helminthology I**

<p><b>Total Hours: 60</b></p>	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To know process of Collection, fixation and staining methods of worms</li> <li>• To understand use of identification keys for cestodes and trematodes.</li> <li>• To learn Histopathology of host and worms</li> </ul>	<p><b>Credits: 4</b></p>
	<p><b>Program specific outcomes</b> After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• Study the Collection, fixation and staining methods of worms</li> <li>• Understand key of Identification for cestodes and trematodes.</li> <li>• Practice the study of Histopathology of host and worms</li> <li>• Study the various types of parasites</li> </ul>	
<p><b>Practical</b></p>	<ul style="list-style-type: none"> <li>• Study of different types of animal associations with suitable examples.</li> <li>• Collection, fixation and preservation of Cestodes from locally available hosts</li> <li>• Collection, fixation and preservation of trematodes from locally available hosts.</li> <li>• Staining and identification of cestodes and preparation of permanent slides</li> <li>• Staining and identification of trematodes and preparation of permanent slides</li> <li>• Histopathology of host tissue, to study host parasites relation</li> <li>• Study of different cestodes (10) and trematodes (10) from permanent slides.</li> <li>• Examination of ova in fecal samples of any suitable animal.</li> <li>• Submission of five permanent slides at the time of practical examination.</li> </ul>	

<b>M. Sc. II: Semester III Core Courses</b>		
<b>Zoo 302 Enzymology and Immunology</b>		
Total Hours: 60	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To acquire the flavour of modern aspects of Zoology/Animal Sciences.</li> <li>• To enable the students to study Enzymology and Immunology as a core course.</li> <li>• To learn practicing skill so that to join public or private labs.</li> </ul>	Credits: 4
	<b>Program specific outcomes</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Know about the Enzymology and Immunology.</li> <li>• To be familiar with the Enzyme structure, properties and its activity</li> <li>• Understand the basic principles of Enzymology and Immunology</li> <li>• To understand the principle and mechanism of immunoglobulins</li> </ul>	Lectures 60
Unit	Topics	
Unit I	<b>Enzyme structure and properties :</b> a) Enzyme Classification and nomenclature (International Union of Biochemistry (I.U.B.); Enzyme Commission number (EC) b) Primary and secondary structure, tertiary structure, the active site, quaternary structure, examples of enzyme- ribonuclease and chymotrypsin and their mechanism of action.	12
Unit II	<b>Enzyme activity:</b> a) Methods of investigating the mechanisms of enzyme catalyzed reactions- Isotopes labeling, b) Kinetics methods (enzyme velocity, units) steady-state methods, continuous methods. c) Steady-state enzyme kinetics- Effect of substrate concentration on initial velocity, d) Michaelis-Menten Hypothesis, Briggs- Haldane Hypothesis, Determination of Km and Vmax.	12
Unit III	<b>Enzyme immobilization and inhibition:</b> a) Enzyme purification techniques, b) Immobilization techniques, experimental procedures, enzyme stabilization, properties of immobilized enzyme c) Enzyme inhibition Competitive, non-competitive and uncompetitive inhibition, d) Allosteric activation and inhibition- sequential and concerned symmetry models.	12

Unit IV	<p><b>Central cell types of the immune system:</b> T and B lymphocytes, the NK cells, the neutrophilic, basophilic and eosinophilic granulocytes and the macrophages</p> <p>Types, structure, and function of molecules: immunoglobulins, T-cell receptors, MHC molecules, complement proteins, a few key cytokines and chemokines and their receptors.</p>	12
Unit V	<ul style="list-style-type: none"> <li>• Defense against as bacteria, fungi, virus and parasites</li> <li>• Mechanisms behind several immunological diseases, as hypersensitivity reactions, allergies, autoimmunity and immuno deficiencies.</li> <li>• Mechanisms of action of certain immunosuppressive drugs as glucocorticoids and cyklosporin.</li> <li>• Immunological methods: ELISA, Western blot, production of monoclonal and polyclonal antibodies</li> </ul>	12
Suggested readings	<ul style="list-style-type: none"> <li>• Immunology (6 th Edition) by Roit IM, Brostoff J and Male D. Mosby, An imprint of Elsevier Sci Ltd., 2002.</li> <li>• Kuby Immunology (4 th Edition) by Golds RA, Kindt TJ, Osborne A. W.H. Freeman and Co. Ltd., New York, USA, 1994.</li> <li>• Textbook on Principles of Bacteriology, Virology and Immunology, 5 Volumes (9 th Edition) by Topley and Wilson. Edward Arnold, London, 1995.</li> <li>• Basic and Clinical Immunology, by Stites DP. Appleton &amp; Lang Press.</li> <li>• Immunology, by Weissman and Wood. Benjamin Cummings.</li> <li>• Fundamentals of Immunology, by Coleman RM, Lombard MF, Sicard RE and Rencricca NJ. Wm. C. Brown Publishers, 1989.</li> </ul>	

<b>MSc I Sem II Core Courses</b>		
<b>Zoo -304: Practical I Corresponding to Zoo 302 Enzymology and Immunology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know process of cell fractionation technique</li> <li>• To analyse the enzyme activity and Km value</li> <li>• To understand immunological techniques</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• acquire the knowledge related to process of cell fractionation</li> <li>• gain practical skill related enzyme analysis and Km</li> <li>• learn various immunological techniques.</li> </ul>	
<b>Practical</b>	<b>Practical corresponding to Enzymology</b> <ul style="list-style-type: none"> <li>• Preparation of tissue homogenate and fractionation of liver cell components</li> <li>• Effect of activators and inhibitors on enzyme activity</li> <li>• Determination of <math>\alpha</math>-amylase by starch digestion</li> <li>• Determination of tryptic activity by casein digestion method</li> <li>• Determination of pancreatic lipase activity</li> <li>• Determination of Km Value of enzyme</li> </ul>	
	<b>Practical corresponding to Immunology</b> <ul style="list-style-type: none"> <li>• Chemistry of immunoglobulin molecules, classes and physiological importance.</li> <li>• Use of ELISA technique (HIV) or any suitable method</li> <li>• Isolation and purification Bovine serum immunoglobulin G (IgG) fraction by suitable method</li> <li>• Study of agglutination reaction and its significance performing WIDAL test.</li> <li>• Determination of Antigen and Antibody reaction by using any suitable method</li> </ul>	

<b>M. Sc. II: Semester III Elective Courses</b>		
<b>ZOO 305 (A) Animal behavior</b>		
Total Hours: 60	<b>Program specific objective</b> 1. The programme has been designed in such a way so that the students get the flavour of both classical and modern aspects of Zoology/Animal Sciences. 2. It aims to enable the students to study Heminthology-1 as a core course. 3. The lab courses have been designed in such a way that students will be trained to join public or private labs.	Credits: 4
	<b>Program specific outcomes</b> The student at the completion of the course will be able to: ➤ Understand the Feeding and Antipredator behavior of animals. ➤ Know about the Aggression, Territoriality and Conflict behavior. ➤ To be familiar with the Biological Communication ➤ Students learn about the Orientation and Navigation	Lectures 60
<b>Unit I</b>	<b>Introduction:</b> 1.1 What is Behavior? Behavioral Ecology.	04
<b>Unit II</b>	<b>Feeding and Antipredator Behavior:</b> 2.1 Food preferences, Feeding Techniques, Using Tools, Feeding in Group-living Herbivores, Social Carnivores, 2.2 Anti Predator Behavior, Concealment, Camouflage, Warning Coloration and Mimicry, Freezing, Escape, Social Antipredator Behavior, Confusion Effect, Detection, The Development of Anti Predator Behavior.	14
<b>Unit III</b>	<b>Aggression, Territoriality and Conflict behavior:</b> 3.1 Forms of Aggressive Behavior, Aggression and Competition, Types of Aggressive Behavior. 3.2 Social Use of Space (Territoriality), Size and Boundaries of Territory, Territorial Model, Dominance Hierarchies, Dominance in Females, Dominance in males, Advantage of Dominance, Factors Affecting aggression, Limbic System, Hormones, Genetic Control, 3.3 External factors in Aggression, Learning and Experience, Pain and Frustration, Xenophobia, Crowding, Breeding, Feeding, Restrain of Aggression, Displays, Territorial Conflicts	14
<b>Unit IV</b>	<b>Biological Communication:</b> 4.1 How signal convey information, Discrete and Graded Signals, Distance and Duration, Composite Signals, Syntax and Context, Metacommunication, Information and Manipulation, Messages and their Meaning, Signals, 4.2 Measurement of Communication, Observation, Quantification, Channels of Communication, Odor, Sound, Touch, Surface Vibration, Electric Field, Vision.	14
<b>Unit V</b>	<b>Orientation and Navigation:</b> 5.1 Navigation, Invertebrates, Topographic Features, Sun, Stellar Cues, Meteorological Cues, Olfactory Cues, Geomagnetic Cues, Mammals, 5.2 Other Navigation Mechanisms.	14
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Reena Mathur: Animal Behaviour, Rastogi Publication, Meerut</li> <li>• M.P.Arora: Animal Behaviour Himalaya Publishing House, Mumbai</li> <li>• Harjindra singh: A text book of Animal Behaviour, Anmol Publiccations Pvt. Ltd, NewDelhi)</li> </ul>	



<b>M. Sc. II: Semester III Elective Courses</b>		
<b>ZOO 305 (B) Forensic Zoology</b>		
Total Hours: 60	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• The programme has been designed in such a way so that the students get the flavour of modern aspects of Zoology/Animal Sciences.</li> <li>• It aims to enable the students to study Forensic Science as a elective course.</li> </ul>	Credits: 4
	<b>Program specific outcomes</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the History and development of forensic science.</li> <li>• Know about the forensic science laboratories.</li> <li>• To be familiar with the Biological evidences, collection and packaging.</li> <li>• Students learn about the analysis of biological fluids</li> </ul>	Lectures 60
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	Forensic Science : Definitions, History and Development Scope and importance of forensic science	06
<b>Unit II</b>	<b>Forensic Science Laboratories And Facilities:</b> Growth of Forensic Science Laboratories in India – Central and State level laboratories; Educational setup in Forensic Science in India; Services and functionalities provided by various FSLs	12
<b>Unit III</b>	<b>Biological Evidences Collection and Packaging:</b> Protection of Biological Evidences; Documentation; Recognition of Biological evidences encountered in various cases; Search & Collection of Biological Evidences; Packaging & transportation of Biological Evidences	15
<b>Unit IV</b>	<b>Analysis of Biological Fluid-</b> Saliva; Semen; Vaginal Fluid; Urine; Sweat; Serological Concepts; Antigen / Antibodies; Polyclonal antibodies; Monoclonal antibodies; Antiglobulins; Human & Animal Hair morphology; Blood Grouping – Human & Non-human; Analysis of Skeletal Remains	15
<b>Unit V</b>	<b>Forensic Entomology</b> Basic Principle of Insect Biology; Life Cycle; Estimation of Time of Death; Preservation of Sample.	12
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Nanda, B.B. and Tewari, R.K. (2001) : Forensic Science in India : A vision for the twenty first century Select Publisher, New Delhi.</li> <li>• James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press, USA.</li> <li>• Barnett (2001): Ethics in Forensic Science.</li> <li>• Saferstien : Forensic Science, Handbook, Vol. I, II &amp; III, Prentice Hall Inc. USA.</li> <li>• Saferstein : Criminalistics, 1976, Prentice Hall Inc., USA.</li> <li>• Nickolas : Scientific Criminal Investigation</li> <li>• Deforest, Gansellen &amp; Lee : Introduction to Criminalistics.</li> <li>• Sharma, B.R. : Forensic Science in Criminal Investigaion and Trials, Central Law Agency, Allahabad, 1974.</li> <li>• Kirk : Criminal Investigation, 1953, Interscience Publisher Inc. New York</li> </ul>	

<b>M. Sc. II: Semester III Elective Courses</b>		
<b>ZOO 305 (C) Endocrinology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• The programme has been designed in such a way so that the students get the flavour of modern aspects of Zoology/Animal Sciences.</li> <li>• It aims to enable the students to study Endocrinology as a elective course.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the Histology of endocrine glands.</li> <li>• Know about the synthesis, transport and metabolism of hormones.</li> <li>• To be familiar with the hormone replacement theory</li> <li>• Students learn about the classification of hormones</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	1.1 Histology of vertebrate endocrine glands: Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pineal and Thymus gland 1.2 Melatonin function: Jet-lag and sleep disturbances. Melatonin as an anti-oxidant. Melatonin and cancer. Melatonin and depressive disorders. Melatonin and endocrine disorders. Adverse effects of Melatonin. 1.3 Histophysiology of endocrine placenta, testis and ovary in vertebrates 1.4 Structure and functions of Islets of Langerhans 1.5 Histophysiology of Urophypophysis and Corpuscles of Staninus in fishes	12
<b>Unit II</b>	2.1 Classification of Hormones (Peptides, Steroids and amino acid derived) a. Hormone action at cellular level 2.3 Hormone action at genetic level 2.4 Hormones in biological clock 2.5 Role of hormones in digestion 2.6 Hormonal regulation of carbohydrate, Lipid and Protein metabolism 2.7 Hormonal regulation of Growth and Reproduction	12
<b>Unit III</b>	3.1 Synthesis, transport (release) and metabolism of steroid hormones 3.2 Synthesis, transport and metabolism of T <sub>3</sub> , T <sub>4</sub> and epinephrine 3.3 Synthesis transport and metabolism of insulin 3.4 Prostaglandins 3.5 Ectohormones in insects and mammals	12
<b>Unit IV</b>	4.1 Thyroid hormones and disorders 4.2 Parathyroid hormones and disorders 4.3 Pituitary hormones and major Disorders 4.4 Adrenal Gland hormones and Disorders 4.5 Diabetes: Diabetes Type I, Diabetes Type II, Diabetic Kidney Problems, Diabetes And Pregnancy, Diabetic Nerve Problems, Autoimmune diabetes 4.6. Comparative study of steroid and non-steroid hormones in	12

	reproduction	
<b>Unit V</b>	5.1 Hormone replacement therapy 5.2 Risks and benefits of Hormone replacement therapy 5.3 Other hormones: Rennin, angiotensin, cytokines, ANF, Erythropoietin 5.4 Evolution of hormones 5.5 Neuroendocrine mechanism in insects and crustacean metamorphosis 5.6 Neuroendocrine mechanism in Amphibian metamorphosis	12
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• .Lohar Prakash S.2014 Endocrinology:Hormone and Human Health.MJP Publishers, Chennai</li> <li>• Human Physiology- C. C. Chatterji Vol. I and II</li> <li>• Comparative Vertebrate Endocrinology, Bentley: Cambridge University Press, 1998</li> <li>• Fundamentals of Comparative Endocrinology, Chester-Jones et al.: Plenum Press, New York, London, 1987.</li> <li>• Comparative Endocrinology, Gorbman et al.: John Wiley &amp; Sons, New York, 1983</li> <li>• Vertebrate Endocrinology, Norris: (2nd ed.), Lea &amp; Febiger, 1997.</li> <li>• Vertebrate Endocrinology Schreibman &amp; Pang: Vol. I-IV,</li> <li>• Fundamentals &amp; Biomedical Implications, Academic Press, 1985 &amp; onwards</li> <li>• Endocrinology, Hadley: Prentice hall. International Edition. 2000</li> <li>• Text Book of Endocrinology, 10th edition Larson: Williams. W. B. Saunders Company, Philadelphia. 2002.</li> <li>• William's text book of Endocrinology. (XI edition) H. M. Kronenberg, S. Melmed, K.S. Polonsky and P. R. Larsen. Publisher - Saunders, Elsevier Inc. (2009).</li> </ul>	

<b>MSc II Sem IV Core Courses</b>		
<b>Zoo- 401: (A) Animal Physiology – I</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To learn about the anatomy and physiology.</li> <li>• To understanding the various systems of animal body.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> <ul style="list-style-type: none"> <li>• To understand the functioning of Animal physiology</li> <li>• To obtain the detail knowledge on structure of animal systems.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>A)Excretion and Osmoregulation</b> i)Definition of Excretion; Types of excretory Products, ii)Comparative aspect of Excretory organs in Invertebrates and Vertebrates, iii)Osmoregulation in Invertebrates and Vertebrates <b>B) Nervous System</b> i)Nervous cordination: Brain; Spinal cord, Neurons ii)Nerve Fibres; Neuroglea; Nerve impulse; Neuromuscular junction; iii) Neurotransmitters; Reflex arc; Types ofReflexes; iv) Evolution of nervous system; v)EEG	<b>12</b>
<b>Unit II</b>	<b>Physiology of Muscles</b> a) Types: Phasic muscles, Tonic Muscles, Striated Muscles,Smooth muscles, Cardiac muscles b) Chemical Composition of Muscle: Water; Proteins; Actin; Myosin; Tropomyosin; Troponin; Actinin; c) Neuromuscular junction; Motor unit; Membrane excitation; d) Mechanism of muscle contraction; Sliding filament theory; e) General properties of Muscles; Properties of Voluntary muscles; Physical and Chemical aspects of muscle contraction; Molecular basis of Muscle contraction; Control of Muscle contraction; f) Role of Regulator proteins and calcium in muscle contraction;Changes during muscle contraction; Single muscle twitch; Latent phase or period; Contraction phase; Relaxation phase; g) Invertebrate muscle, h) Tetanus	<b>14</b>
<b>Unit IV</b>	<b>Endocrine System</b> a) Properties and types of Hormones, Mechanism of Hormone action b) The Pituitary Gland: Pituitary Gland in Different Chordates, It Hormones, c) Gigantism, Acromegaly, Dwarfism; d) Thyroid Gland: Cretinism, myxoedema, exophthalmic Goitre; e) Parathyroid Gland: Functions of PTH, Disorders of parathyroid; f) Pancreas: Islets of Langerhans: Diabetes g) Adrenal Gland: Addison’s disease, Cushing’s syndrome;	<b>14</b>

	<p>h) Thymus Gland: Thymosin;  i) The pineal Gland: Melatonin,  j) Reproductive glands; Testes; Prostate gland, Ovary; Placenta;  k) Gastrointestinal hormones; Renal Hormones; Prostaglandins;  l) Endocrine Glands in Invertebrates: Neurosecretory cells and Neurosecretion; Neurosecretion in Insects; Pheromones</p>	
<b>Unit V</b>	<p><b>Reproductive System</b>  a) Patterns of Animal Reproduction: Asexual and Sexual  i) Sexual Reproduction; Male Reproductive System- Spermatogenesis, Transportation of sperm, Composition of Semen; Female Reproductive System- Puberty; Oogenesis; Graafian Follicles; Menstrual cycle; Ovulation; Fertilization; Implantation; Oestrus Cycle:  b) Hormonal Control of Reproductive Cycle; Menopause;  c) Hormonal Control of Pregnancy; Parturition;  d) Hormonal Control of Lactation</p>	<b>12</b>
<b>Unit VI</b>	<p><b>Sensory Physiology</b>  a) Sensory coding - Transduction, Relationship between Stimulus Intensity and Response, Central control of Sensory Reception;  b) Chemoreception - Gustation and Olfaction;  c) Thermoreceptors and Infrared reception;  d) Mechanoreception, Mechanotransduction - Invertebrate and vertebrate Mechanoreceptors - Muscles spindle,  e) Acoustico lateralis System,  f) Echolocation;  g) Electroreception;  h) Magnatoreception</p>	<b>08</b>
	<b>Total</b>	<b>60</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Prakash S Lohar: Endocrinology-Hormones and Human Health, MJP Publishers, Chennai</li> <li>• G. J. Tortora: Principle of Anatomy and Physiology</li> <li>• Hoar: General and Comparative physiology</li> <li>• Dr. P.V. Jabade: General Physiology</li> <li>• B.K. Berry: Animal Physiology</li> <li>• C.C. Chatterjee: Human Physiology</li> <li>• Goel and Shastri: Textbook of Animal Physiology</li> <li>• K.S. Nelson: Animal Physiology</li> <li>• Holurn: Principles of Physiology and Biochemistry</li> <li>• Bell and Davidson: Textbook of Physiology and Biochemistry</li> <li>• Harper, Physiological chemistry</li> <li>• Mariakuttikan N. Arumugam: Animal Physiology</li> <li>• Itta Sambasiviah, A. P. Kamalakara Rao, S. Augustiane Chellappa: A Textbook of Animal Physiology and Ecology</li> </ul>	

<b>MSc I Sem II Core Courses</b>		
<b>Zoo 403 Practical correspond to Zoo - 401 (A) Animal Physiology II</b>		
	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To understand the process of determining GFR</li> <li>• To analyse reflexes in man an sensivity</li> <li>• To understand process of ovulation, semen analysis</li> </ul>	<p><b>Credits:</b> <b>2</b></p>
	<p><b>Program specific outcomes</b></p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• acquire the knowledge related to determination of GFR</li> <li>• gain the knowledge related to reflexes in man</li> <li>• understand the process of ovulation and semen analysis.</li> </ul>	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1) To demonstrate the principle of dialysis.</li> <li>2) Determination of GFR.</li> <li>3) Determination of Nitrogenous Excretory Product – Uric acid</li> <li>4) Reflexes in man.</li> <li>5) Study of different types of muscles.</li> <li>6) Super-ovulation in Rat.</li> <li>7) To study the oestrous cycle by vaginal smear method.</li> <li>8) Assessing skin sensitivity - locating different receptors.</li> <li>9) Study of Endocrine glands with the help of Slides/ Photographs</li> <li>10) Qualitative estimation of hCG.</li> <li>11) Perform Semen analysis (Motility, Sperm count, Morphology of sperm)</li> <li>12) Isolation of Haemoglobin.</li> </ol>	

<b>MSc II Sem IV Core Courses</b>		
<b>Zoo – 401 B: Reproductive Physiology-II</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To learn about the various aspects of reproductive physiology and events.</li> <li>• To acquire a broad understanding of the hormonal regulation of physiological processes.</li> <li>• To create awareness of new technologies in assisted reproduction as well as contraceptive methods.</li> <li>• To build healthy society by providing proper knowledge related to reproductive aspects.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• Understand the functioning of male and female reproductive systems particularly in humans.</li> <li>• Comprehension of the interplay of various hormones in the functioning and regulation of the male and female reproductive systems.</li> <li>• Know about infertility</li> <li>• Know about modern contraceptive devices</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>Fertilization-</b> <ul style="list-style-type: none"> <li>• Ejaculation, Insemination,</li> <li>• Gamate transport (ovum and sperm)</li> <li>• Sperm capacitation and activation</li> <li>• Entry of sperm into ovum, Acrosomal reaction, Activation of ovum</li> <li>• Significance of fertilization</li> <li>• Early development:- Early cleavages, blastomeres</li> </ul>	<b>12</b>
<b>Unit II</b>	<b>Implantation and Pregnancy</b> <ul style="list-style-type: none"> <li>• Morphological and physiological relationship between blastocyst and uterus during implantation.</li> <li>• Abnormal implantation</li> <li>• Hormonal changes during pregnancy.</li> <li>• Ectopic pregnancy and pseudo pregnancy</li> <li>• Role of Hormones during Pregnancy:- Progesterone hCG, HPL, relaxin</li> </ul>	<b>12</b>
<b>Unit III</b>	<b>Placenta, Parturition and Lactation</b> <ul style="list-style-type: none"> <li>• Formation and development of placenta</li> <li>• Histological structure of placenta</li> <li>• Endocrine functions of placenta</li> </ul> <b>Parturition</b> <ul style="list-style-type: none"> <li>• Initiation of labour</li> <li>• Properties of uterine muscles</li> <li>• Process and factors involved in parturition</li> </ul> <b>Lactation</b> <ul style="list-style-type: none"> <li>• Development of mammary gland</li> <li>• Hormonal control on the Functions of mammary gland</li> </ul>	<b>12</b>

	<ul style="list-style-type: none"> <li>• Lactogenesis</li> </ul>	
<b>Unit IV</b>	<p><b>Reproductive Health</b></p> <ul style="list-style-type: none"> <li>• Definition, Reproductive Health Care programme</li> <li>• Goals of RCH programme</li> <li>• <b>Birth Control Methods</b></li> <li>• <b>A) Natural Temporary methods :-</b> Safe period, Coitus inerruptus, Lactational amenorrhea</li> <li>• <b>B) Male and female contraceptives with their Advantages and disadvantages :-</b> Chemical means, Mechanical means ( Barrier), Physiological devices(Oral pills), Birth control Implants</li> <li>• <b>C) Permanent method: -</b> Tubectomy, Vasectomy</li> </ul>	<b>12</b>
<b>Unit V</b>	<p><b>Problems and Remedies related to Reproduction</b></p> <ul style="list-style-type: none"> <li>• MTP (Medical Termination of Pregnancy)</li> <li>• Amniocentesis , PNDT Definition and Legal acts</li> <li>• Sexually Transmitted Diseases:- Syphilis, Gonorrhoea</li> <li>• Male and female infertility(sterility)</li> <li>• Artificial/assisted reproductive techniques :- IVF, GIFT, ZIFT, ICSI, AI, IUI, Surrogacy, Sperm bank.</li> </ul>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Prakash S Lohar, 2012 – Endocrinology Hormones and Human Health, MJP Publishers, Chennai</li> <li>• P. J. Hogarth, 1978- Biology of Reproduction Wiley, New York.</li> <li>• J. S. Perry, 1971- The Ovarian cycle of animals, Oliver and Boyed.</li> <li>• C.R. Austin and R. V. Short, 1972 Reproduction in Mammals, Vol. 1-8, Cam. Uni. Press.</li> <li>• P. Gibian and E.J. Platz, eds, 1970- Mammalian Reproduction, Springer Verlag.</li> <li>• Robert H. Williams, 1981 – Text book of Endocrinology, W. B. Saunders Company</li> <li>• Chandi Charan Chatterjee, 1985 – Human Physiology Vol.II Tenth Edition, Medical Allied Agency, Calcutta, India.</li> <li>• Arthur J. Vander, James H. Sherman and Dorothy S. Luciano – Human Physiology,</li> <li>• Mcgraw-Hill International Editions, Biological Sciences Series.</li> <li>• Nalbandov, A. V.- Reproduction Physiology.</li> </ul>	



<b>MSc I Sem II Core Courses</b>		
<b>Zoo 403 Practical correspond to Zoo - 401 (B) Reproductive Physiology II</b>		
	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To know different stages of embryonic development</li> <li>• To study placenta and types of contraceptives</li> <li>• To estimate biochemicals associated with reproduction</li> </ul>	<b>Credits: 2</b>
	<p><b>Program specific outcomes</b></p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• acquire the knowledge related to embryonic development</li> <li>• gain the knowledge related to histology of placenta and types of contraceptives</li> <li>• Estimate biochemicals associated with reproduction.</li> </ul>	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Study of various stages of development of mammalian egg, cleavage, blastula, gastrula.</li> <li>2. Study of histological slides of placenta.</li> <li>3. Study of types of contraceptives.</li> <li>4. Demonstration of surgical operation in rat/mice- tubectomy.</li> <li>5. Demonstration of surgical operation in rat/mice- vasectomy.</li> <li>6. Collection of Mammalian sperms.</li> <li>7. Pregnancy test (immunological)</li> <li>8. Estimation of total gonadal (testis) cholesterol from rat/mice.</li> <li>9. Estimation of total adrenal cholesterol from rat/mice.</li> <li>10. Estimation of Ascorbic acid from Ovary / Testis.</li> <li>11. Estimation of Protein from Ovary / Testis by Lowry's method</li> <li>12. Estimation of Glycogen from Ovary / Testis by Anthrone Method</li> </ol>	

<b>MSc II Sem IV Core Courses</b>		
<b>Zoo - 401: (C) Entomology II</b>		
<b>Insect Physiology and Applied Entomology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To develop a strong foundation in entomology, including understanding of the importance of insects to human society.</li> <li>• To know the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction.</li> <li>• To familiarize the students with identification of insect pests, vectors and their control methods.</li> <li>• To develop a sufficient background for those students who wish to study more advanced entomological topics.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• Acquire the knowledge of process the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction.</li> <li>• Understand the systematic position, habit and habitat of Insects pests.</li> <li>• Acquire the knowledge about morphology, physiology, ecology, behavior and physiology of insect pests.</li> <li>• Acquire the knowledge of identification of insect pests, vectors and their control methods.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
	<b>Insect Physiology</b>	
<b>Unit I</b>	A) Penetration of substances through cuticle B) Nutritional requirement and Mechanism of Digestion C) Circulation : a) Circulatory Mechanisms in Terrestrial and Aquatic insects b) Control of Heart beat D) Excretion in Terrestrial and Aquatic insects E) Respiration : a) Diffusion theory of respiration b) Respiratory Mechanisms in Terrestrial and Aquatic insects	<b>12</b>

<b>Unit II</b>	A) Physiological Properties of Insect Muscle B) Locomotion - Terrestrial, Aerial and Aquatic C) Neural Integration and Sense Organs D) Role of Hormones in Reproduction, E) Metamorphosis and Regeneration	<b>12</b>
<b>Applied Entomology</b>		
<b>Unit III</b>	General biology of important pests of crops cultivated in Maharashtra in particular and India in general : A) Agricultural Crop pests: Sugarcane, Paddy, Maize, Jawar. B) Fiber crop pests: Cotton, Jute C) Vegetable pests: Bhendi, Brinjal, Cabbage, Pea, Chillies, Onion. D) Fruit pests: Lemon, Mango, Guava, Ber-cucurbita E) Oil seed plant: Ground nut, Castor, Soyabean, Mustard, Sesamum	<b>12</b>
<b>Unit IV</b>	A) Important pests of forest trees and steps taken to check their infestation : a) Termites, c) Forest defoliators, b) Borers d) Sap suckers B) Household and stored grain pests their control : a) Rice weevil, c) Pulse beetle, b) Tribolium d) Rice moth	<b>12</b>
<b>Unit V</b>	A) Medical and Veterinary entomology with reference to important Vectors and their control measure : a) Mosquito, b) Housefly, c) Flea and d) Sand fly B) Integrated pests Management (I.P.M.), C) Role of insects in forensic science	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Bursell E.: An Introduction to Insect Physiology, Academic Press Inc. New York, 1978</li> <li>• Crop pests and how to fight them: Govt. of Maharashtra Pub. Bombay.</li> <li>• Pfadt R.E.: Fundamental of Applied Entomology, Mac Millan, New York, 2<sup>nd</sup> Ed.1971.</li> <li>• Pradhan S.: Insect pests of crop, NBY, New Delhi 1969.</li> <li>• Rock Stein M.: The Physiology of Insects by Vol. I- VI, Academic press London 1973-76.</li> <li>• Roy D. N. and A WA Brawn: Entomology, The Bangalore Printing and Publ. Co. Ltd. 1970.</li> <li>• Short JRI: Introduction to Applied Entomology, Longmans Green London 1963.</li> <li>• Simi KGV Trustees of Britmus London: Insects and other Arthropods of Medical importance, 1973.</li> <li>• Wigglesworth V. B.: The principles of Insect Physiology, Chapman and Hall Ltd. London. 7th Ed. 1972.</li> </ul>	

<b>MSc II Sem IV Core Courses</b>		
<b>Zoo - 403: Practical I (corresponding to Zoo 401 (C) Entomology II)</b>		
<b>Insect Physiology and Applied Entomology</b>		
<b>Total Hours: 60</b>	<p><b>Program specific objective</b></p> <ul style="list-style-type: none"> <li>• To develop a strong foundation in entomology, including understanding of the importance of insects to human society.</li> <li>• To know the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction.</li> <li>• To familiarize the students with identification of insect pests, vectors and their control methods.</li> <li>• To develop a sufficient background for those students who wish to study more advanced entomological topics.</li> </ul>	<b>Credits: 2</b>
	<p><b>Program specific outcomes</b></p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> <li>• Acquire the knowledge of process the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction.</li> <li>• Understand the systematic position, habit and habitat of Insects pests.</li> <li>• Acquire the knowledge about morphology, physiology, ecology, behavior and physiology of insect pests.</li> <li>• Acquire the knowledge of identification of insect pests, vectors and their control methods.</li> </ul>	
	<b>Insect Physiology</b>	
	<ul style="list-style-type: none"> <li>• Detection of chitin in insects</li> <li>• Detection of CaCO<sub>3</sub> in Malphigian tubules of cockroach</li> <li>• Study of haemocytes in insect haemolymph</li> <li>• Detection of Uric acid in Malphigian tubules of cockroach</li> <li>• Estimation of Amylase activity in alimentary canal of Cockroach</li> <li>• Counting of Heart beats of cockroach by using normal insect saline and effect of drugs, temperature on Heart beats</li> </ul>	
	<b>Applied Entomology</b>	

	<ul style="list-style-type: none"> <li>• Study of insect pests of agricultural importance <ul style="list-style-type: none"> <li>• Agricultural crop pests: Maize, Sugarcane</li> <li>• Pests of Vegetables: Bhendi, Brinjal, Cabbage</li> <li>• Pests of Fiber Crops: Cotton and Jute</li> <li>• Pests of Fruit Plants: Lemons, Mango, guava.</li> <li>• Pests Oil Seeds: Ground nut, Soyabean</li> </ul> </li> </ul>	
	<ul style="list-style-type: none"> <li>• Study of Insect Vectors of Man: Mosquitoes, House fly, Bedbug, Head louse</li> <li>• Study of Insect Pest of Cattle and Domestic Animals: Mite, Horn fly, Horse fly</li> </ul>	
	<ul style="list-style-type: none"> <li>• Study of Stored Grain and Household Pests: Flour beetle, Rice weevil, Pulse beetle</li> <li>• Study of Forest Pests: Termites, Borers, Defoliators etc.</li> <li>• Study of Forensic Insects: Flesh fly, Blow fly</li> <li>• Compulsory Field Trip: To visit Agriculture University, Institute etc.</li> </ul>	
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Bursell E.: An Introduction to Insect Physiology, Academic Press Inc. New York, 1978</li> <li>• Crop pests and how to fight them: Govt. of Maharashtra Pub. Bombay.</li> <li>• Pfadt R.E.: Fundamental of Applied Entomology, Mac Millan, New York, 2<sup>nd</sup> Ed.1971.</li> <li>• Pradhan S.: Insect pests of crop, NBY, New Delhi 1969.</li> <li>• Rock Stein M.: The Physiology of Insects by Vol. I- VI, Academic press London 1973-76.</li> <li>• Roy D. N. and A WA Brawn: Entomology, The Bangalore Printing and Publ. Co. Ltd. 1970.</li> <li>• Short JRI: Introduction to Applied Entomology, Longmans Green London 1963.</li> <li>• Simi KGV Trustees of Britmus London: Insects and other Arthropods of Medical importance, 1973.</li> <li>• Wigglesworth V. B.: The principles of Insect Physiology, Chapman and Hall Ltd. London. 7th Ed. 1972.</li> </ul>	

<b>M. Sc. II: Semester IV Core Courses</b>		
<b>Zoo 401 (D) Helminthology-II</b>		
Total Hours: 60	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• The programme has been designed in such a way so that the students get the flavour of classical and modern aspects of Zoology/Animal Sciences.</li> <li>• It aims to enable the students to study Heminthology-II as a core course.</li> <li>• The lab courses have been designed in such a way that students will be trained to join public or private labs.</li> </ul>	Credits: 4
	<b>Program specific outcomes</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the Helminthology-II.</li> <li>• Know about the classification of Nematodes.</li> <li>• To be familiar with the life cycle of various nematodes</li> <li>• Students learn about the Nature, pathogenicity and prevention of ecto and endoparasites.</li> <li>• Their identification, nature of damage control of these nematodes.</li> </ul>	Lectures 60
<b>Unit</b>	<b>Topics</b>	
Unit I	1. General control measure of endo-parasites. Chemical, Biological, Physical/ Mechanical, Culture and Legislative. 2. Economic importance of parasites, direct or indirect effect on human, animal, farm animals and agriculture, poultry and fisheries pathogenicity. 3. General pattern of parasitic transmission. 4. Parasitic zoonosis.	14
Unit II	Study of medically and veterinary important Parasitic Nematodes. a. Intestinal nematodes infective in egg stage. b. Intestinal nematodes infective in larval stage. c. Blood & tissue dwelling nematodes	08
Unit III	1. Feeding and nutrition's in Nematodes. 2. Reproductive system in male, female, fertilization, development and hatching of eggs. 3. Molting and Development in nematodes. 4. Different life cycle patterns in Nematodes. 5. Morphology, life cycle, pathogenicity, control and Prevention of following types. a. <i>Strongyloides stercoralis</i> b. <i>Wuchereria bancrofti</i> c. <i>Trichenella spiralis</i> d. <i>Trichuris trichura</i>	16

	e) <i>Dracunculus medinensis</i>	
Unit IV	1. General organization and Outline classification of plant Nematodes. 2. Feeding habits and modifications in anterior region. 3. Symptoms of Nematode injuries to plants (above ground. below ground)	10
Unit V	1. Controlling nematode diseases of plants (Cultural, biological, chemical, physical, legislative) 2. Life cycle studies of followings a. Root knot Nematodes ( <i>Meloidogyne</i> ) b. Citrus Nematodes ( <i>Tylenchulus</i> ) c. Bud and leaf Nematodes ( <i>Aphelenchoides</i> ) d. Seed gall Nematodes ( <i>Anguina</i> )	12
Suggested Readings	<ul style="list-style-type: none"> <li>• Text book of medical Parasitology - Dey</li> <li>• Structure of Nematode - Allen bird</li> <li>• An introduction to Nematodology - Chitwood</li> <li>• Organization and Biology of nematodes -Crool</li> <li>• Physiology of nematodes - Lee</li> <li>• Principal of Nematodology - Throne</li> <li>• Applied Parasitology - Hiware, Jadhav and Mohekar</li> <li>• Physiology of nematode parasite - Smith</li> <li>• Animal Nematodes from Indian Mammals - Nama, Shinde and Jadhav</li> <li>• Vertebrate Nematodes - York and Mapelston</li> <li>• Physiology of nematode parasites - Bee</li> <li>• Nematodes Parasites of domestic animal - Levine</li> <li>• Structure of Nematodes -Allen Bird</li> <li>• Biology of nematode - Crool</li> </ul>	

<b>MSc I Sem II Core Courses</b>		
<b>Zoo 403 Practical correspond to Zoo - 401 (D) Helminthology II</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To understand the process of Study the Collection, fixation and staining methods of nematodes</li> <li>• To understand key of Identification for nematodes.</li> <li>• To practice camera lucida for sketching of nematodes</li> <li>• To study the various types of nematodes in vertebrates</li> </ul>	<b>Credits: 2</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• Study the Collection, fixation and staining methods of nematodes</li> <li>• Understand key of Identification for nematodes.</li> <li>• Practice camera lucida for sketching of nematodes</li> <li>• Study the various types of nematodes in vertebrates</li> </ul>	
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Techniques for collection and Fixation of nematodes from various hosts.</li> <li>• Basic techniques of preservation and mounting of Nematodes.</li> <li>• Identification of collected nematodes.</li> <li>• Sketching of the nematodes with the help of Camera Lucida</li> <li>• Examination of fecal sample of sheep, goat and chicken for different helminthes ova and their identification.</li> <li>• Study of permanent whole mount slides: (At least 8).</li> </ul>	



	<ul style="list-style-type: none"><li>• Submission of permanent slides at the time of examination.</li><li>• Visit to veterinary and medical parasitology laboratory</li></ul>	
--	--	--

<b>MSc II Sem IV Core Courses</b>		
<b>Zoo – 402: Molecular Biology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To understand the basic structure of cells, tissues and their working system.</li> <li>• Know the handling skill in laboratory methods of estimation, determination, working of cells and their molecules.</li> <li>• Use of binocular research microscope and bioinstrumentation in laboratory.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• Acquire skills related to molecular analysis of biological species, cells and tissues.</li> <li>• Predict the outcome of various cellular reactions carried out in cell and cellular system under various conditions.</li> <li>• Predict the role of genes and its relevance to human genetics and diseases.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms	<b>12</b>
<b>Unit II</b>	RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport	<b>12</b>
<b>Unit III</b>	Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proofreading, translational inhibitors, post- translational modification of proteins.	<b>12</b>
<b>Unit IV</b>	Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing	<b>12</b>
<b>Unit V</b>	Tools and Techniques in Molecular Biology. i. Polymerase chain reaction (PCR); ii. Electrophoresis- PAGE, SDS - PAGE and Agarose gel electrophoresis. iii. Blotting techniques: Southern, Northern and Western blotting iv. ELISA technique and v. DNA finger printing	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Prakash S. Lohar : Cell and Molecular Biology, MJP Publishers, Chennai</li> </ul>	

	<ul style="list-style-type: none"> <li>• Gerald Karp: Cell and Molecular Biology, John Wiley and Sons International, London</li> <li>• H.S. Bhamrah: Molecular Cell Biology</li> <li>• J.D. Watson: Molecular Biology of the gene</li> <li>• P.K. Gupta: Cell and Molecular Biology</li> </ul>	
--	--	--

<b>MSc I Sem II Core Courses</b>		
<b>Zoo 403 Practical correspond to Zoo - 402 Molecular Biology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To know process of making paper model of DNA</li> <li>• To estimate DNA and demonstrate vital staining</li> <li>• To understand the process of AGE and PAGE</li> </ul>	<b>Credits: 2</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• acquire the knowledge related to preparation of DNA model</li> <li>• learn the process of estimation of DNA and vital staining</li> <li>• understand the process of AGE and PAGE.</li> </ul>	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Study of cell fractionation (D)</li> <li>2. Preparation of Paper Model of DNA (D)</li> <li>3. Extraction of DNA from rat liver/ Spleen (E)</li> <li>4. Estimation of DNA from suitable material by Diphenylamine reagent. (E)</li> <li>5. Estimation of RNA from suitable material by Orcinol reagent. (E)</li> <li>6. Vital staining of mitochondria by using Janus Green B stain. (E)</li> <li>7. Preparation of salivary gland chromosome from Chironomus / Drosophila larva. (E)</li> <li>8. Isolation of Genomic DNA from suitable material.</li> <li>9. Determination of Thermal melting point (<math>T_m</math>) of nucleic acid.</li> <li>10. Isolation of plasmid DNA and detection by Agarose gel electrophoresis.</li> <li>11. Detection of protein by PAGE and molecular determination.</li> <li>12. Gene mapping in Prokaryotes problem.</li> </ol>	

<b>MSc II Sem IV <u>Zoo 404: Project</u></b>		<b>Credit 4</b>
<b>Special Instruction</b>	Project on suitable topic should be given to each student in the beginning of 3 <sup>rd</sup> Semester and through the year work should supervised and finally Project Report with following points should be typed, bind (at least 30 pages) and submitted to department before final examination (4 <sup>th</sup> Semester).	
	<b>Title of the Project:</b> Define a short, significant title which reflects clearly the contents of the report.	
	<b>Abstract:</b> Succint abstract of less than one page.	
	<b>Table of content:</b> The table of content lists all chapters (headings/subheadings) including page number	
	<b>Introduction:</b> Explain why this work is important giving a general introduction to the subject, list the basic knowledge needed and outline the purpose of the report.	
	<b>Background and results to date:</b> List relevant work by others, or preliminary results you have achieved with a detailed and accurate explanation and interpretation. Include relevant photographs, figures or tables to illustrate the text. This section should frame the research questions that your subsequent research will address.	
	<b>Aims and Objectives:</b> List the main research question(s) you want to answer. Explain whether your research will provide a definitive answer or simply contribute towards an answer.	
	<b>Methodology:</b> Explain the methods and techniques which will be used for your project depending on the subject: field work, laboratory work, modeling technique, interdisciplinary collaboration, data type, data acquisition, infrastructure, software, etc.	
	<b>Discussion / Conclusion:</b> Explain what is striking/noteworthy about the results. Summarize the state of knowledge and understanding after the completion of your work. Discuss the results and interpretation in light of the validity and accuracy of the data, methods and theories as well as any connections to other people's work. Explain where your research methodology could fail and what a negative result implies for your research question	
	<b>Acknowledgement:</b> Thank the people who have helped to successfully complete your project, like project partners, tutors, etc.	
	<b>Reference &amp; Literature (Bibliography):</b> List papers and publication you have already cited in your proposal or which you have collected for further reading. The style of each reference follows that of international scientific journals.	

	<b>Appendix:</b> Add pictures, tables or other elements which are relevant, but that might distract from the main flow of the proposal.
--	---

<b>MSc II Sem IV Elective Course (Any one from A,B and C)</b>		
<b>Zoo 405 (A): Zoogeography</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• The course is designed to provide students with an understanding of zoogeography, the study of the spatial patterns, or geography, of animals.</li> <li>• Examine environmental and zoogeographic patterns</li> <li>• Develop an understanding of the influence of earth history and basic zoogeographic processes on animals</li> <li>• Explore the application of zoogeography to conservation of animals</li> <li>• The course will finish by applying this knowledge to an understanding of current issues in biodiversity.</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• show mastery in the broad areas of environmental factors and their variation on various spatial and temporal scales</li> <li>• learn ecological and evolutionary biogeography, and application of such knowledge to conservation biology.</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>Introduction to Zoogeography</b> <ul style="list-style-type: none"> <li>• History. Concepts- Zoogeography.</li> <li>• Definitions, Nature, Scope, Principles, Disciplines – Geography, Plant ecology and evolution, Geology, Ethnology</li> <li>• Environmental and geographical settings Physical Setting: the Geographic Template</li> <li>• The Changing Earth, continental drift.</li> </ul>	<b>12</b>
<b>Unit II</b>	<b>The Geography of Communities</b> <ul style="list-style-type: none"> <li>• Distributions of communities</li> <li>• Glaciation and its biotic effects</li> <li>• Glaciation and Biogeographic Dynamics of the Pleistocene</li> <li>• Speciation and its geographical context Endemism, cosmopolitanism, and disjunction</li> <li>• Classification and Mapping of Animals.</li> <li>• Factors of animal mapping: Shape of area, Structure of area, Ecology of area, History of area, Relict area, Geography of area, Dynamic of area, Community area, areas of Aquatic animals.</li> </ul>	<b>12</b>

<b>Unit III</b>	<p><b>Dispersal and Immigration</b></p> <ul style="list-style-type: none"> <li>• Animal Dispersal :- Factors of Animals dispersal: – Climate, Vegetation, Physical barriers, other animals.</li> <li>• Types of Animals dispersal- Active, Passive, Gradual, Rapid, Seasonal, Forced, Anthropogenic.</li> <li>• Barriers of Animals dispersal – Physical, climatic, biological Water, Ecological, Living environment, Time and distance.</li> <li>• Modes of dispersal</li> <li>• Dispersal routes of faunas.</li> </ul>	<b>12</b>
<b>Unit IV</b>	<p><b>The Geography of Diversification</b></p> <ul style="list-style-type: none"> <li>• Types of distribution of animals- Areography, Ecogeographic Rules, and Diversity Gradients</li> <li>• The Distribution of Species: Ecological Foundations</li> <li>• Distributions of single species,</li> <li>• Types of Distribution continuous discontinuous Bipolar.</li> <li>• Bathymetric distribution- Geobiotic Limnobiotic Holobiotic.</li> <li>• Theories of distribution of animals climatic and evolution theory of Matthew, age and area theory of Willis</li> <li>• Zoogeographical regions of the world with characteristic fauna</li> </ul>	<b>12</b>
<b>Unit V</b>	<ul style="list-style-type: none"> <li>• Eco- Geographic System Concept, Allen’s Eco-geographic system, evolution of new species and their causes, faunal main and sub-regions-land, aquatic.</li> <li>• Factors affecting on ecology of animals - light , weather , food , temperature, space, mobility, shelter, soil , plant formation and size of population.</li> <li>• Marine realm and characteristics. Biogeography and the Geography of Extinction Conservation Biogeography</li> </ul>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Frank Evers Beddard (2008): A Text-Book of Zoogeography, Published by BiblioBazaar,</li> <li>• John R. Merrick (2006): Evolution and Biogeography of Australasian Vertebrates. Publisher</li> <li>• Savindra Singh (1997): Environmental science, Prayang Pustak Bhawan, Allahabad</li> <li>• Tiwari S.K. (1985): Zoo-Geography of India and South East Asia. International Book Dist. Dehra Dun.</li> <li>• Tiwari, S. K Wallace.(2006): Fundamentals of World Zoogeography. Vedams eBooks (P) Ltd (India)</li> <li>• Wallace A.R., (1962): The geographical distribution of animals. Hafner Publ. Co.</li> <li>• Illies, J .1974 .Introduction to zoogeography .Macmillan .</li> <li>• International commission for zoological Nomenclature(ICZN). 1999 . International code of zoological Nomenclature. Nature History Museum Cromwell Road, London S W 7 5BDUK</li> <li>• .Kapoor, v.c Theory and practice of Animal Taxonomy Oxford – IBH publishing co., N Delhi ,Mumbai &amp; Kolkata .</li> <li>• Mayer , E. Principles of systematic zoology . Mc-Graw Hill publication, New Delhi Simpson , G.C. Principles of Animal Taxonomy. Oxford –IBH publishing co, New Delhi</li> </ul>	

<b>MSc II Sem IV Elective Course</b>		
<b>Zoo – 405 (B): Writing and Presenting Scientific Research Paper</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To understand the process of writing, presentation and publication of research paper</li> <li>• To learn the skills related to presentation of paper</li> <li>• To avoid the mistakes in writing research paper</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• acquire the knowledge of writing, presentation and publication of research paper</li> <li>• gain the skills related to presentation of paper</li> <li>• learn to avoid the mistakes in writing research paper</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<b>Introduction to writing research project</b> Purpose of writing research report of dissertation and thesis, style and structure of research report, preliminary section. <b>Review of Literature</b> Purpose, method and Types: Aargumentative, Integrative, Historical, Methodological, systematic and theoretical.	<b>12</b>
<b>Unit II</b>	<b>Writing a research report:</b> Main body of the report, - introduction, review of literature, methods of study, results and analysis of data, summary, suggestion, conclusion of data and reference section. <b>General precautions</b> , editing and correction, final evaluation of research report, <b>IMMRAD</b> pattern of research report.	<b>12</b>
<b>Unit III</b>	<b>Use of visual aid for effective presentation:</b> Power point presentation: Synopsis, summary, abstract, tables, graphs, Summary, References, Acknowledgement Poster presentation: Appropriate size of the poster with Title, author,	<b>12</b>

	affiliation, introduction material and methods, results, summary selection of appropriate font size, table, figure, etc	
<b>Unit IV</b>	<b>Common mistakes in writing scientific paper</b> <ul style="list-style-type: none"> <li>• Unclear aim</li> <li>• Structure of the manuscript is confusing</li> <li>• Methods without enough details</li> <li>• Wrong statistic used</li> <li>• Sections are mixed up</li> <li>• Conclusions do not match with present results</li> <li>• Writing inaccurate</li> <li>• Citations/references are incomplete</li> </ul>	<b>12</b>
<b>Unit V</b>	<b>Guidelines for paper publication:</b> <ul style="list-style-type: none"> <li>• Formatting of the paper as per rules of <b>journal</b></li> <li>• Guidelines for Author.</li> <li>• Submission of Article.</li> <li>• Assigned Reviewers.</li> <li>• Decision by Reviewers.</li> <li>• Reviews to the Author.</li> <li>• Updated Paper Received.</li> <li>• Feedback.</li> </ul>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Dr. Nageshwar Rao and Dr. Rajendra P. Das: Communication Skills, HimalayaPublishing House 2005</li> <li>• Margerson, J.E.: The Art of effective communication, Excel Books New Delhi</li> <li>• Richard, W. Clark and Barbara, L. Clinton: Effective Speech Communication, MacMillan, Mac Graw Hill, New York, 1999</li> <li>• N. Gurumani, Research Methodology for biological sciences, MJP publishers,Chennai</li> <li>• Gopen, G.D. and Swan J.A. The Science of Writing, American Scientist, 1990</li> <li>•• Hall, G.M. How to write a paper, By Word publication, 1996</li> </ul>	



<b>MSc II Sem IV Elective Course</b>		
<b>Zoo – 405 (C):Computational Biology</b>		
<b>Total Hours: 60</b>	<b>Program specific objective</b> <ul style="list-style-type: none"> <li>• To get introduced to the basic concepts of Computational biology</li> <li>• To overview about types of Biological data and database search tools.</li> <li>• To acquire knowledge about computational tools for Proteomics and Genomics</li> </ul>	<b>Credits: 4</b>
	<b>Program specific outcomes</b> After successful completion of this course, students are expected to: <ul style="list-style-type: none"> <li>• learn the basic concepts of Computational biology</li> <li>• gain knowledge about types of Biological data and database search tools.</li> <li>• acquire skill to use computational tools for Proteomics and Genomics</li> </ul>	<b>Lectures 60</b>
<b>Unit</b>	<b>Topics</b>	
<b>Unit I</b>	<ul style="list-style-type: none"> <li>• Definition, Objectives and scope of Computational Biology</li> <li>• Application of Bioinformatics in various Fields.</li> <li>• Concept of Biological database</li> <li>• Types and significance of biological database</li> </ul>	<b>12</b>
<b>Unit II</b>	<ul style="list-style-type: none"> <li>• Concept of Sequence alignment</li> <li>• Types of sequence alignment</li> <li>• BLAST, types and applications</li> <li>• FASTA, format and applications</li> </ul>	<b>12</b>
<b>Unit III</b>	<ul style="list-style-type: none"> <li>• Proteomics : Definition and significance</li> <li>• Protein structure visualization tools</li> <li>• Protein sequence databases-</li> <li>• Protein folding and disorders</li> <li>• PDB and Protein microarray</li> </ul>	<b>12</b>

<b>Unit IV</b>	<ul style="list-style-type: none"> <li>• Genomics: Definition and significance</li> <li>• Comparative, structural and functional genomics</li> <li>• DNA microarray</li> <li>• Human Genome Project</li> </ul>	<b>12</b>
<b>Unit V</b>	<p>A) Computational analysis of the genomics of</p> <ul style="list-style-type: none"> <li>• <i>Escherchia coli</i></li> <li>• <i>Drosophila melanogaster</i></li> <li>• <i>Rattus rattus</i></li> </ul> <p>B) GenBank, DDBJ, EMBL</p>	<b>12</b>
<b>Suggested Readings</b>	<ul style="list-style-type: none"> <li>• Attwood, T.K., Michie, A.D. and Jones, M.L.(1996): DbBrowser: integrated access to databaseworldwide. <i>TiBS</i>. Vol. 21(5), 191.</li> <li>• Barnes, M.R. and Gray, I.C.(2003) eds.,<i>Bioinformatics for Geneticists</i>, first edition. Wiley,ISBN 0-470-84394-2</li> <li>• Prakash S.Lohar (2011) Bioinformatics ISBN 978-81-8094-066-8 MJP Publishers, Triplicane, Chennai.</li> <li>• Lesk, A.M. (2001): <i>Introduction to ProteinArchitecture: The Structural Biology of Proteins</i>(Oxford: Oxford University Press).</li> <li>• Pocock,M.R. et al. (2000) BioJava: open sourcecomponents for bioinformatics. ACM SIGBIO</li> </ul>	

**Kavayitri Bahinabai Chaudhari  
North Maharashtra University, Jalgaon  
M. Sc. (Part I) Zoology  
Equivalence 2017-18 (Old courses) with 2021-22 (New Courses)**

Paper Code	Old Courses 2017-18	Paper Code	New Courses 2021-22
<b>Semester I</b>			
ZOO 101	Structure and Function of Invertebrates	ZOO 101	Structural and Functional Anatomy of Invertebrates
ZOO 102	Cell and Developmental Biology	ZOO 102	Cellular Organization and Developmental Biology
ZOO 103	Quantitative Biology	ZOO 103	Practical I: Zoo 101
ZOO 104	Practical	ZOO 104	Practical I: Zoo 102
ZOO 105	Practical	ZOO 105	Goatary (Skill based)
		AC 101	Practicing Cleanliness
<b>Semester II</b>			
ZOO 201	Structure and Function of Vertebrates	ZOO 201	Structural and Functional Anatomy of Vertebrates
ZOO 202	Biochemistry and Enzymology	ZOO 202	Biochemistry
ZOO 203	Tools and Techniques for Biology	ZOO 203	Tools and Techniques in Biology
ZOO 204	Practical	ZOO 204	Practical I: Zoo 201+202+203
ZOO 205	Practical	ZOO 205	Aquaculture and Ecology (Skill based)
		Audit Course	Any one
		AC-201A	Soft Skills
		AC-201B	Sport Activities
		AC-201C	Yoga
		AC-201D	Music

KBC North Maharashtra University, Jalgaon  
**M. Sc. (Part II) Zoology**  
**Equivalence 2018-19 (Old courses) with 2022-23 (New Courses)**

Paper Code	Old Courses 2018-19	Paper Code	New Courses 2022-23
<b>Semester III</b>			
ZOO 301 (Any one from A,B,C,and D) Specialized paper	(A) Entomology I or (B) Animal Physiology I (C) Reproductive Physiology I (D) Helminthology I	ZOO 301 (Any one from A,B,C,and D) Specialized paper	(A) Animal Physiology I (B) Reproductive Physiology I (C) Entomology I (D) Helminthology I
ZOO 302	Immunology and Molecular Biology	ZOO 302	Enzymology and Immunology
ZOO 303	Genetics	Elective course ZOO 303 (Any one)	Animal Behaviour Forensic Zoology Endocrinology
		Audit Course	Any one
		AC-301A	Computer Skills
		AC-301B	Cyber Security
		AC-301C	Seminar + Review Writing
		AC-301D	Biostatistics
ZOO 304	ZOO 304: Practical 301 + 302	ZOO 304	Practical I: Zoo 301
ZOO 305	ZOO 305: Practical 302 + 303	ZOO 305	Practical II: Zoo 302
		AC-301 Audit Course	Any one
		AC-301A	Computer Skills
		AC-301B	Cyber Security
		AC-301C	Seminar + Review Writing
		AC-301D	Biostatistics
<b>Semester IV</b>			
ZOO 401 (Any one from A,B,C,and D) Specialized paper	(A) Entomology II or (B) Animal Physiology II or (C) Reproductive Physiology II or (D) Helminthology II	ZOO 401 (Any one from A,B,C,and D) Specialized paper	(A) Animal Physiology II (B) Reproductive Physiology II (C) Entomology II (D) Helminthology II
ZOO 402	Systematic and Evolutionary Biology	ZOO 402	Molecular Biology
ZOO 403	Skill in Communication and	ZOO 403	A) Zoogeography

	Writing Research Paper	Elective (Select any one)	B) Writing scientific research paper C) Computational Biology
ZOO 404	ZOO 404: Practical 401 + 402	ZOO 404	Practical I: Zoo 401 + Zoo 402
ZOO 405	ZOO 405: Practical 402 + 403	ZOO 405	Project
		Audit Course	Any one
		AC-401A	Human Rights
		AC-401B	Current Affairs
		AC-401C	Seminar + Review Writing
		AC-401D	Intellectual Property Rights (IPR)