

# **Savitribai Phule Pune University**

(Formerly University of Pune)

Two Year Post graduate Degree Program in Zoology (Faculty of Science & Technology)

**Revised Syllabus as per National Education Policy - 2020 for** 

## M. Sc. (Zoology) Part - II

(For Colleges Affiliated to Savitribai Phule Pune University)

Syllabus to be implemented from the Academic Year 2024 - 2025

## **BOARD OF STUDIES IN ZOOLOGY,**

Savitribai Phule Pune University, Pune – 411 007

Year	Level	Semester III				
		Course	Subject	Credit s		
			ZOO 601 MJ : Animal Physiology – I / Entomology – I / Genetics – I	04		
			ZOO 602 MJ : Physiology of Reproduction	02		
			ZOO 603 MJ : Developmental Biology	02		
		Major	ZOO 604 MJ : Insect Physiology & Biochemistry	02		
			ZOO 605 MJP : Laboratory Exercises in			
		Core	Animal Physiology – I /	02		
			Entomology – I / Genetics – I			
			ZOO 606 MJP : Laboratory Exercises in			
			Physiology of Reproduction and	02		
			Insect Physiology &			
			Biochemistry			
2	6.5		ZOO 607 MJ : Applied Genetics	02		
			Applied	02		
		Major	Genetics	02		
		Elective	ZOO 609 MJ : Animal Behaviour	02		
			ZOO 610 MJP : Laboratory Exercises in Animal			
			Behaviour	02		
		Research Project	ZOO 611 RP : Research Project	04		
		NOTE :				
		1. Major (	Core = ( ZOO 601 MJ to ZOO 604 MJ = 10 C +	14		
		ZOO 60	5 MJP to ZOO 606 MJP = 4C ) (Major Core of			
		10 + 4 =	14 Credits are Compulsory ).			
		2. Major I	Clective = Students can choose any two courses	0.4		
		from ( 2	$200\ 607\ MJ$ to $200\ 610\ MJ$ ) equivalent to $2+2$	04		
	= 4 Credits.					

	<b>3.</b> ZOO 611 RP : Research Project is compulsory for all students.	04
	Total	22

Year	Level		Semester IV				
		Course	Subject	Credits			
			ZOO 651 MJ : Animal Physiology – II / Entomology – II / Genetics – II	04			
			ZOO 652 MJ : Ecology and Evolution	02			
			ZOO 653 MJ : Environmental Biology	02			
		Major	ZOO 654 MJP : Laboratory Exercises in				
		Core	Animal Physiology – II /	02			
			Entomology – II / Genetics – II				
			ZOO 655 MJP : Laboratory Exercises in				
			Ecology, Evolution and	02			
	6.5		<b>Environmental Biology</b>				
			ZOO 656 MJ : Applied Entomology	02			
2		6.5 Major	ZOO 657 MJP : Laboratory Exercises in	02			
-			Applied Entomology	02			
		Elective	ZOO 658 MJ : Immunology	02			
			ZOO 659 MJP : Laboratory Exercises in	02			
			Immunology	02			
		Research Project	ZOO 660 RP : Research Project	06			
		NOTE :					
		1. Major	Core = ( ZOO 651 MJ to ZOO 653 MJ = 8 C +	10			
		ZOO (	554 MJP to ZOO 655 MJP = 4C ) (Major Core of 8	12			
		+ 4 = 1	2 Credits are Compulsory).				
		2. Major	Elective = Students can choose any two courses				
		from (	ZOO 656 MJ to ZOO 659 MJ ) equivalent to 2 + 2	04			
		= 4 Cr	edits.				

	3. ZOO 660 RP : Research Project is compulsory for all	06
	students.	00
	Total	22

## Title of the Course : M. Sc. (Zoology)

### **SEMESTER - III**

	ZOO 601 MJP : Animal Physiology – I								
	Teaching Scheme Marking Scheme								
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total		
П	Ш	Major Core	04	04	30	70	100		

#### **Course Outcomes :**

After successfully completing this course, students will be able to :

- CO1: Understand homeostasis and regulation as well as Biological clock and their regulation.
- CO2: Illustrate bioluminescence and animal electricity with examples and its significance.
- CO3: Explain regulation of total body energy balance.
- CO4: Explain Haematopoiesis, blood clotting, the anatomy and physiology of heart, cardiac cycle, nervous and hormonal control of heart.
- CO5: Explain the structure of muscles, mechanism of muscle contraction, types and diseases of bones.
- CO6: Understand nervous excitation as well as structure & disorders of eye.
- CO7: Acquire the knowledge of anatomy & working of nervous system.
- CO8: Understand various reflexes related to physiology of animals.

		Lectures
Sr. No.	Topics	Allotted
		(L)
		(1

	Environmental physiology :	
	<b>1.1</b> Internal environment: extracellular and intracellular environment.	
1.	<b>1.2</b> Homeostasis and regulation: tolerance and resistance, acclimatization and acclimation, molecular mechanism of thermal	6
	acclimation in poikilotherms.	
	<b>1.3</b> Biological clock and their regulation : circadian rhythms, lunar	
	and tidal rhythm, circa annual rhythm, photoperiodism.	
	Bioluminescence and animal electricity:	
	<b>2.1</b> Phyletic distribution, structure of luminescent organs,	
2.	biochemical and molecular mechanism.	6
	2.2 Animal electricity: electro receptors, electro organs - structure	
	and functions.	
	<b>Regulation of total body energy balance :</b>	
	<b>3.1</b> Basic concept of energy expenditure and caloric balance:	
3	determinants of metabolic rate, total body energy balance, control	6
5.	of food intakes, obesity, and anorexia nervosa.	U
	<b>3.2</b> Regulation of body temperature: heat production, heat loss	
	mechanism.	
	Circulation :	
	4.1 Haematopoiesis, hemostasis, blood clotting and its molecular	
Λ	mechanism.	8
4.	4.2 Heart: Electric activity of heart, pace maker spreading of cardinal	0
	capillary, action potential of cardiac cells, mechanism of cardiac	
	cycle, heart sound, nervous and hormonal control of heart.	
	Musculo-Skeletal System :	
	5.1 Structure of skeletal muscle and molecular basis of skeletal	
F	muscle contraction and chemical basis of muscle contraction,	
	neuromuscular junction.	0
5.	<b>5.2</b> Innervation of muscles, excitation and contraction coupling.	,
	<b>5.3</b> Structure and function of bones, types of bone, bone marking,	
	healing of bones.	
	5.4 Diseases of bones: osteoporosis, Paget's disease, rickets and	

	osteomalacia, osteomyelitis.	
	Special Senses :	
	6.1 Structure of eye, physiology of eye sight, extra ocular muscle of	
	eye, accessory organs of eye.	
6	6.2 Disorders of eye: inflammatory conditions, glaucoma, cataract,	5
0.	refactoring errors of the eye.	5
	<b>6.3</b> Structure of ear, physiology of hearing, balance and equilibrium.	
	6.4 Disorders of ear: hearing loss, ear infection, labyrinthitis,	
	motion sickness.	
	Nervous excitation :	
	7.1 Definition: impulse, stimulation, conduction, response, EEG,	
	epilepsy.	
	7.2 Response of nervous tissue to injury, head injury, cerebral	
	hypoxia, stroke, dementia, parkinson's.	
7	7.3 Gross neuro anatomy of the brain and spinal cord.	10
7.	7.4 Neural control of muscle tone and posture.	10
	7.5 Neurotransmitter type and receptors.	
	7.6 Metabolism of neurotransmitter, neuropeptide, synapse and	
	neuronal integration, origin and conduction of nerve impulse.	
	7.8 Impact of drug and disease or synaptic transmission.	
	7.9 Integration of nervous and endocrine control.	
	Control of body movement :	
	<b>8.1</b> Overview of the motor system: voluntary and involuntary	
	actions.	
	<b>8.2</b> Local control of motor neurons.	
8.	<b>8.3</b> Length monitoring system and the stretch reflex: alpha- gamma	5
8.	coactivation.	· ·
	<b>8.4</b> Tension monitoring system.	
	8.5 Descending pathway -	
	A. Cortico-spinal pathway.	
	B. Multi neuronal pathway.	

- Animal Physiology: Adaptation and Environment (1997) Knut Schmidt-Nielsen Publisher: Cambridge University Press.
- Human physiology: the mechanism of body function (1986): Arthur J. Yander, JAMES H Sherman, Dorothys Luciano,4<sup>th</sup> edition McGraw; Hill international edition,
- Principles of Animal Physiology (2006), C. D. Moyes and P. M. Schulte. Publisher Pearson Education Inc. and Dorling Kindersley Publishing Inc.
- Text book of Medical Physiology 10th edition (2001), A. C. Guyton and J. E. Hall. Publisher W.
   B. Saunders Company, Philadelphia.
- 5. Principles of Anatomy and Physiology, 11th edition (2006), G. J. Tortora and B. Derrickson. Publisher-John Wiley and Sons Inc.
- Endocrinology, 5th edition (2008), Mac. E. Hadley. Publisher-Pearson Education Inc. and Dorling Kindersley Publishing Inc.
- 7. Comparative Vertebrate Endocrinology 3rd edition (1998), P. J. Bentley. Publisher Cambridge University Press.
- 8. Vertebrate Endocrinology 3rd edition (1997), D. O. Norris. Publisher- Academic Press: An imprint of Elsevier.
- 9. The World of the Cell, 7th edition, (2005), Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin., Publisher Benjamin Cummings.
- 10. Animal Physiology, Third Edition (2012) Richard W. Hill, Gordon A. Wyse, Margaret Anderson
- 11. Functional Anatomy and Physiology of Domestic Animals 4th Edition (2009) William O. Reece
- 12. Animal Physiology 2nd Edition Richard W. Hill Publisher: Sinauer Associates, Incorporated
- Eckert's Animal Physiology (2004) Roger Eckert, D.J. Randall, Warren Burggren, Kathleen French Publisher: W. H. Freeman & Co Ltd
- Principles of Animal Physiology (2013) Christopher D. Moyes, Patricia M. Schulte Publisher: Pearson Education Limited
- Environmental Physiology of Animals (2004) Pat Wilmer, Graham Stone, Ian Johnston Publisher: Blackwell Publishing Ltd
- 16. Introduction to Animal Physiology (1998) Ian Kay Publisher: Bios Scientific Publishers Ltd
- 17. Comparative Animal Physiology-Prosser C. L.
- Text book of physiology: George H. Bell Donald Emslie Smith Colin Paterson Tenth Edition The English language book society and Churchill Livingstone
- 19. Animal physiology Adaptations and environment Knut Schmidt –Nielsen fourth edition Cambridge university press Cambridge New York port Chester Melbourne Sydney
- 20. Animal physiology Mechanisms and Adaptations Third Edition Roger Eckert E.H. Freeman and Company, New York
- 21. General and Comparative Physiology Third Edition Wiliam S.Hoar prantice –Hall of India New Delhi 110015.

	ZOO 601 MJP : Entomology - I								
	Teaching Scheme Marking Scheme								
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total		
Π	Ш	Major Core	04	04	30	70	100		

#### **Course Outcomes :**

After successfully completing this course, students will be able to :

- CO1: Understand origin and evolution of insects and their relation to other arthropods.
- CO2: Classify insects up to family with distinguishing characters and examples of each order and family.
- CO3: Explain the structure, chemical composition and functions of Integument and Derivatives of Integument.
- CO4: Explain the structure of insect body regions and their appendages.
- CO5: Identify different modifications in Antennae, Wings, and Legs of an insect.
- CO6: Understand the Comparative anatomical and histological structure of various body systems.
- CO7: Explain the location structure and functions of various Endocrine and Exocrine glands.
- CO8: Explain the location and structure of Light and Sound producing organs in various insects.

Sr. No.	Topics	Lectures Allotted (L)
1.	<ul><li>Introduction to Entomology :</li><li>1.1 Definition &amp; scope.</li><li>1.2 Origin, evolution and inter-relationship of insects with other arthropods.</li></ul>	4
2.	<ul><li>Classification of insects up to Family :</li><li>2.1 Importance of Taxonomic keys.</li><li>2.2 Apterygote insects. (4 orders)</li></ul>	19

	<b>2.3</b> Exopterygote insects. (16 orders)	
	2.4 Endopterygote insects. (9 orders)	
	Integument :	
3.	<b>3.1</b> Structure, chemical composition and functions.	2
	<b>3.2</b> Derivatives of integument: cuticular appendages & processes.	
	Comparative study of :	
	4.1 Head - orientations & articulations and its appendages - antenna,	
	mouth parts; compound eye - structure, modifications & functions.	
4.	4.2 Thorax and its appendages: wing & leg - structure,	9
	modifications & functions.	
	4.3 Abdomen and its appendages - pre genital and genital	
	appendages.	
	Comparative anatomical and histological study of the followings	
	:	
	<b>5.1</b> Digestive system.	
	<b>5.2</b> Respiratory system.	
5.	<b>5.3</b> Circulatory system.	20
	<b>5.4</b> Excretory system.	
	<b>5.5</b> Reproductive system.	
	<b>5.6</b> Nervous system.	
	5.7 Sense organs.	
6.	Endocrine and exocrine glands and hormonal action.	4
7.	Light and sound producing organs.	2

- 1. A Text book of Entomology, H. H. Ross, John Wiley and Sons, Ins. New York.
- 2. An Introduction to Entomology, J. H. Comstock, Ithaca, New York.
- General & Applied Entomology, K. K. Nayar, T.N. Anathakrishnan & B.V. David, Tata McGraw-Hill, New Delhi.
- General Entomology, 2<sup>nd</sup> edition, M.S. Mani Oxford & IBH Publishing Company, New Delhi.
- 5. Imm's text book of entomology, Vol. I and II, O. W. Richards and R. G. Davies, Methuen and com, London.

- 6. Introduction to comparative Entomology, R. M .Fox and J. W. Fox, Reinhold, New York.
- 7. Modern Entomology, 2nd edition, D. B. Tembhare, Himalaya Publication House, Mumbai.
- 8. Principles of insect morphology, R. E. Snodgrass, Tata Mc-Graw Hill, Mumbai.
- 9. The Insect: Structure & Function, R. F. Chapman, E.L.B.S. & E.U.P., London.

	ZOO 601 MJ : Genetics – I							
	Teaching Scheme Marking Scheme							
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total	
II	III	Major Core	04	04	30	70	100	

#### **Course Outcomes :**

After successfully completing this course, students will be able to :

- CO1 : The course gives detailed idea about applications of genetics in different areas.
- CO2 : To understand genetic engineering and its tools, components involved in cloning and recombinant gene technology.
- CO3: Understand the fundamentals of Mendelian genetics and the extensions of his principles.
- CO5: Comprehend the principles of genetics in the level of genes and molecules.
- CO6: Able to learn the genetic and molecular basis of sex determination and dosage compensation.
- CO7: Provide historic overview of evolutionary thought and how a fully formed evolutionary theory was put-forth, learn the forces that drive evolution and their mode of action in the level of population.
- CO8: Know the various isolation mechanisms and their role in speciation.
- CO9: Familiarize the students with mode of action of evolution in molecular level.
- CO10: To build strong understanding of the process of gene regulation in prokaryotes and eukaryotes.
- CO11: Introduce the students to emerging fields such as epigenetics and the epigenetic regulation of gene expression.

CO12: Build strong foundation to the microbial model organisms used in genetic research.

CO13: Introduce the students to fundamental of inheritance and pattern of inheritance.

Sr. No.	Topics	Allotted
		(L)
	Basic genetics :	
	<b>1.1</b> Mendelism and extension of Mendelism.	
	<b>1.2</b> Chi-square test and its application in analysis of genetic data.	
	<b>1.3 Fine structure of gene :</b>	
	Evolution of gene concept - definition of factors, alleles, multiple	
	alleles, pseudoalleles, beadle and tatum's one gene one enzyme	
	concept, one gene one polypeptide concept, complementation test,	
	intragenic complementation, Cistron, Recon and Muton e.g. lz gene	
	in Drosophila (Lozenge gene), rII locus in T4 phage.	
	1.4 Quantitative genetics :	
	Polygenic inheritance, concept of continuous variation, phenotypic	
1.	variance and its partitioning into subcomponents, QTL, co-variance,	14
	correlation and regression, degree of genetic determination,	
	measurement of heritability, quantitative inheritance in humans.	
	1.5 Concept of linkage :	
	Experiments of Bateson and Punnet, Morgans experiment, genetic	
	recombination and construction of linkage maps in Drosophila,	
	interference and coincidence, mitotic recombination.	
	1.6 Extranuclear inheritance :	
	Organelle heredity: chloroplast-variegation in 4'o clock plant;	
	mitochondria- petite in Saccharomyces, maternal effect- shell	
	coiling in Limnaea, cytoplasmic inheritance - Paramecium (Kappa	
	Particle).	
	Microbial genetics :	
2.	2.1 Bacterial genome organization, recombination in bacteria and	6
	gene mapping.	

	2.2 Methods of gene transfer in bacteria :	
	Transformation - natural transformation systems, mechanism, gene	
	mapping by transformation, chemical-mediated and electro-	l
	transformation; conjugation - nature of donor strains and	
	compatibility, interrupted mating and temporal mapping, Hfr, F12	
	heteroduplex analysis, chromosome transfer in other bacteria; gene	l
	mapping using conjugation data; transduction - generalized and	l
	specialized transduction; gene mapping by specialized transduction,	
	abortive transduction.	
	Advanced Population Genetics :	
	3.1 Recapitulation of basic concepts :	
	Mendelian Population (gene pool, allele and genotype frequencies,	
	Hardy-Weinberg genetic equilibrium and its applications).	
	3.2 Evolutionary forces and estimation of gene frequencies in	
	population through mathematical derivations : mutation, migration,	
	selection (types of selection, selection coefficient, selection in	
3.	natural populations and strategies of selection), selection-mutation	8
	equilibrium.	
	<b>3.3</b> Exercises for solving problems based on 3.2.	
	<b>3.4</b> Assortative mating, inbreeding and genetic drift.	
	3.5 Inbreeding and heterosis :	
	Measurement of inbreeding -inbreeding coefficient, panmictic	
	index, inbreeding pedigree: path diagram construction and problem	
	solving, assortative and disruptive mating, heterosis.	
	Evolutionary Genetics :	
	4.1 Polymorphism:	
	Chromosomal, DNA and allozyme polymorphism in natural	
	population, adaptive genetic polymorphism, balanced	
4.	polymorphism and heterosis, genetic coadaptation.	6
	4.2 Molecular evolution:	
	Patterns of change in nucleotide and amino acid sequences,	
	molecular clock, neutral theory of molecular evolution, conversion	
	of genetic distance into divergence time, kinds of molecular data	

	used in phylogenetic analysis, phylogenetic considerations based on	
	nucleotide and amino acid data, construction of phylogenetic tree.	
	Molecular genetics :	
	<b>5.1</b> Recapitulation of central dogma.	
	5.2 Regulation of gene expression:	
	Regulation of transcription initiation: operon and regulon, positive	
	and negative regulation, enhancers and promoters, transcription	
	factors: types, DNA binding motifs, regulation by attenuation and	
	anti-termination, post transcriptional regulation: alternative	
5.	splicing, transport and targeting of RNA, post-transcriptional gene	8
	silencing, translational control and targeting of proteins, mechanism	
	of steroid hormone and stress induced gene expressions.	
	5.3 Epigenetics:	
	Introduction to concept and definition of epigenetics and epigenetic	
	memory, epigenetic landscape, molecular basis of epigenetics -	
	DNA methylation, histone modifications, non-coding rnas,	
	applications of epigenetics.	
	Principles of genetic engineering :	
	<b>6.1</b> Historical perspective, concept and significance.	
	6.2 A basic layout of R-DNA laboratory.	
	6.3 Molecular tools used in recombinant DNA technology :	
	DNA modifying enzymes – restriction enzymes, ligases,	
6.	polymerases, alkaline phosphatases, nucleases (mode of actions &	4
	applications).	-
	6.4 Vectors used in recombinant DNA technology :	
	Plasmids and plasmid vectors, phages and phage vectors,	
	phagemids, cosmids, artificial chromosome vectors (YAC, BAC,	
	HAC), shuttle vectors and expression vector cloning hosts (E. coli,	
	Saccharomyces, plant and animals cells).	
	Basic Human genetics :	
7.	7.1 History of human genetics.	10
	7.2 Pedigree:	

Gathering family history, pedigree symbols, construction of	
pedigrees, analysis of inheritance patterns : autosomal inheritance-	
dominant & recessive, monogenic traits (sex linked inheritance, sex	
limited & sex-influenced traits, mitochondrial traits), MIM number.	
7.3 Presentation of molecular genetic data in pedigrees.	
7.4 Complications to the basic pedigree patterns- non penetrance,	
variable expressivity, pleiotropy, late onset, dominance problems,	
genetic heterogeneity, genomic imprinting & uniparental disomy,	
spontaneous mutations, mosaicism & chimerism, male lethality, X-	
inactivation.	
7.5 Mechanism of genetic sex determination in humans, dosage	
compensation, genomic imprinting.	
7.6 Genetic basis of male infertility, genetic basis of female	
infertility, genetics of pregnancy loss.	
7.7 Embryonic stem cells and their applications.	

- An Introduction to Genetic Analysis A.J.F. Griffiths, J. Doebley, C. Peichel, D.A. Wassarman (12th ed.) W.H. Freeman Publ. 2020.
- 2. Concepts of Genetics W.S. Klug and M.R. Cummings (12th ed.) Pearson Publ. 2019.
- 3. Genetics : A conceptual approach B.A. Pierce (6th ed.) W.H. Freeman Publ. 2016.
- Lewin's GENES XII J.E. Krebs, E.S. Goldstein, S.T. Kilpatrick. Jones and Bartlett Publ. 2018.
- Human Molecular Genetics T. Strachan and A. Read (5th ed.) Garland Science Publ. 2018.
- 6. Genetics M.W. Strickberger (3rd ed.) Pearson India Publ. 2015
- Principles of Genetics E.J. Gardner, M.J. Simmons, D.P. Snustad (8th ed.) John Wiley & Sons 2006.
- Genetics: Analysis of Genes and Genomes D.L. Hartl and E.W. Jones (6th ed.) Jones & Bartlett Publ. 2004.
- 9. Strickberger's Evolution B. Hall (4th ed.) Jones and Bartlett Publ. 2008.
- 10. Gene Cloning: An introduction, Brown, T. A. 1995, Chapman and Hall, London.
- 11. Genomes 3, Brown T. A. 2007, Garland Science Publishing, New York
- 12. Genes VIII, Lewin, B 2003, Oxford University Press. Oxford

 Molecular Biology of Gene V Edition, Watson, J. D., T. A. Baker S. P. Bell, A Cann, M. Levine and R. Losick, 2004, Pearson Education RH Ltd. India.

	ZOO 602 MJ : Physiology of Reproduction								
Teaching Scheme     Marking Scheme									
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total		
II	IV	Major Core	02	02	15	35	50		

#### **Course Outcomes :**

After successfully completing this course, students will be able to:

CO1: Explain the male and female reproductive systems.

CO2: Understand reproductive patterns.

CO3: Understand the sexual cycles with examples.

CO4: Illustrate the process of fertilization.

CO5: Explain the hormonal regulation in pregnancy.

CO6: Describe the hormonal co-ordination of reproductive processes.

CO7: Know the artificial control of reproduction.

CO8: Understand process of placenta formation, lactation, parturition, etc.

Sr. No.	Topics					
1.	<ul> <li>Reproductive Systems:</li> <li>1.1 Anatomy of male reproductive system, accessory organs and their function spermatogenesis, function of sertoli cells, blood testis barriers, leydig cell, capacitation, functions of androgens.</li> <li>1.2 Anatomy of female reproductive system, female duct - system, external genitalia, mammary gland, oogenesis : process and hormonal control</li> </ul>	6				

2	Reproductive patterns: environmental factors and breeding,	2				
2.	continuous and seasonal breeders.	2				
	Sexual cycles :					
	3.1 Puberty, oestrous and menstrual cycles and its hormonal					
3.	regulation.	4				
	3.2 Ovarian cycle and its hormonal regulation, cycling of non-					
	pregnant uterus and vagina.					
	Hormonal regulation :					
	GnRH, pituitary gonadotropins, behavioural effects, testicular					
4.	hormones, testosterone derivatives, inhibin, ovarian hormones	4				
	pituitary gonadal axis, oestrogen, progesterone's feedback					
	relationships, prostaglandins and their role in reproduction.					
	Fertilization :					
	<b>5.1</b> Gamete transportation.					
	<b>5.2</b> Pregnancy: conception and blastocyst formation.					
5.	<b>5.3</b> Implantation and delayed implantation.	4				
	<b>5.4</b> Hormonal regulation in pregnancy.					
	5.5 Artificial reproductive physiology : Test tube, IVF, ZIFT,					
	GIFT, TET, POST.					
6.	Formation, types and functions of placenta.	2				
7	Parturition, birth process, Ferguson reflex, neuroendocrine	2				
7.	control, purperium.	2				
	Lactation :					
8	8.1 Anatomy and growth of mammary glands, lactogenesis and	2				
0.	galactopoiesis.	2				
	8.2 Hormonal regulation and suckling reflex.					
9.	<b>Reproductive dysfunctions :</b> aging and reproduction.	1				
	Artificial birth control :					
	10.1 Increasing reproductive potential, artificial insemination, in					
10.	vitro fertilization and embryo transfer, induced breeding.	3				
	10.2 Physical, physiological, surgical, chemical methods of					
	contraception in male & female. Infertility - its causes and treatment.					

#### M. Sc. II (Zoology)

- Austin C. R. and Short R. V., Reproduction in mammals Books 1-5, Univ. of Cambridge
- 2. Hogarth P. H. Biology of Reproduction, Blackie and Son, Glasgow, London.
- 3. Nalbandov, AV, Reproductive Physiology, Lea and Febiger , Philadelphia
- 4. Turner and bagnara .General Endocrinology Sixth Edition, W.B. Saunders Company.

ZOO 603 MJ : Developmental Biology								
Teaching Scheme					Mar	king Scheme		
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total	
II	III	Major Core	02	02	15	35	50	

#### **Course Outcomes :**

After completing the course student will be able to :

- CO1: Understand advantages and disadvantages of different model organisms used in research.
- CO2: Learn the processes of organogenesis.
- CO3: Understand mechanism of vertebrate eye development.
- CO4: Acquire the knowledge of molecular signaling during neural induction.
- CO5: Acquire the knowledge of post embryonic development such as apoptosis, aging and senescence.
- CO6: Understand importance of environmental cues in normal animals development.
- CO7: Understand the mechanism of evolutionary changes.
- CO8: Learn the concept of teratogen and different abnormalities caused by teratogens.

Sr. No.	Topics	Lectures Allotted (L)
	Introduction to Developmental biology & Model systems :	
	1.1 Invertebrates : Drosophila melanogaster.	
1.	1.2 Pisces : Zebra fish - Danio rerio.	5
	<b>1.3</b> Amphibians : African clawed frog - <i>Xenopus laevis</i> .	
	1.4 Birds : Chicken.	

	1.5 Mammals : Mouse.				
	Organogenesis :				
	2.1 Neural competence and molecular signaling during neural				
	Induction.				
2	<b>2.2</b> Development of neural tube in chick.	6			
2.	<b>2.3</b> Primary and secondary neurulation.	U			
	<b>2.4</b> Development of tetrapod limb : Formation of limb bud,				
	generating the proximal distal axis of limb.				
	<b>2.5</b> Development of vertebrate eye.				
	Environmental regulation of normal development :				
	<b>3.1</b> Environmental cues and normal development.				
	3.2 Predictable environmental differences as cues for				
3.	development.	5			
	<b>3.3</b> Phenotypic plasticity : Polyphenism and reaction norms,				
	predator induced defenses.				
	<b>3.4</b> Mammalian immunity as a predator - induced response.				
	Programmed cell death, aging and senescence :				
	4.1 Apoptosis.				
1	<b>4.2</b> Pathways of apoptosis : Intrinsic and extrinsic.	5			
т.	<b>4.3</b> Aging and senescences : Programmed theory, telomeric theory,	5			
	free radical theory.				
	<b>4.4</b> Promoting longevity : Role of telomerase.				
	Developmental mechanism of evolutionary change :				
	5.1 Mechanism of evolutionary change : Heterotopy,				
5	heterochrony, heterometry, heterotypy.	4			
J•	<b>5.2</b> Developmental constraints on evolution – Physical,	т			
	morphogenetic and phyletic.				
	<b>5.3</b> Modularity of development : Duffy blood group substance.				
	Teratogenesis :				
	6.1 Alcohol.				
6.	6.2 Diabetes.	5			
	<b>6.3</b> Thyroid conditions.				
	<b>6.4</b> Autoimmune diseases.				

<b>6.5</b> Thalidomide.	
6.6 Folic acid antagonists.	

- Developmental Biology, R. M. Twyman, Publisher Bios Scientific, Publishers Ltd. (2001).
- An Introduction to Embryology, 5<sup>th</sup> edition, B. I. Balinsky. Publisher Thomas Asia Pvt. Ltd. (2004).
- Principles of Development, 5<sup>th</sup> edition, Lewis Wolpert, Publisher- Oxford, University Press. (2018).
- Developmental Biology, 12<sup>th</sup> edition, Michael J Barresi and S.F. Gilbert. Publisher Sinauer, Associates Inc. (2020).
- Analysis of Biological Development, 2<sup>nd</sup> edition, Klaus Kalthoff, McGraw Hill Science / Engineering / Math. (2000).

ZOO 604 MJ : Insect Physiology & Biochemistry								
Teaching Scheme				Mar	king Scheme			
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total	
II	III	Major Core	02	02	15	35	50	

#### **Course Outcomes :**

After successfully completing this course, students will be able to:

- CO1: Explain the structure, chemistry and functions of various systems of insects.
- CO2: Explain and understand the process of excretion, detoxification and water balance.
- CO3: Elaborate the role of insect hormones in physiological processes.
- CO4: Describe the structure, physiology and biochemistry of flight muscle.
- CO5: Describe the process of protein, carbohydrate, lipid digestion and metabolism in insect body.
- CO6: Explain the characteristics of haemolymph and types of haemocytes.
- CO7: Understand the endocrine system and various hormones.
- CO8: Understand the process of insecticide degradation and detoxification.

		Lectures
Sr. No.	Topics	Allotted
		(L)
	Insect Integument :	
	<b>1.1</b> Structure.	
1.	<b>1.2</b> Chemistry.	3
	<b>1.3</b> Sclerotization.	
	1.4 Functions.	
	Digestion and absorption of Biomolecules :	
2	<b>2.1</b> Proteins.	2
2.	<b>2.2</b> Carbohydrates.	5
	<b>2.3</b> Lipids.	
	Fat body :	
	<b>3.1</b> Structure.	
3.	<b>3.2</b> Physiology and biochemistry.	4
	<b>3.3</b> Functions.	
	<b>3.4</b> Integration of carbohydrate, fat and acid metabolism.	
	Ventilatory system :	
4.	<b>4.1</b> Ventilatory mechanisms.	3
	<b>4.2</b> Control of ventilation.	
	Haemolymph :	
5	5.1 Physico-chemical characteristics of plasma.	2
5.	<b>5.2</b> Types and structure of haemocytes.	5
	<b>5.3</b> Functions.	
	Muscles :	
6.	<b>6.1</b> Structure.	3
	6.2 Physiology and biochemistry of flight muscles.	
	Excretion and water balance :	
7.	7.1 Structure and function of malpighian tubules.	4
	7.2 Water balance and nitrogen excretion.	
0	Endocrines and neurosecretory hormones :	A
δ.	8.1 Chemistry, physiology and functions.	4

	<b>8.2</b> Mechanism of hormone action.	
	<b>8.3</b> Moulting and juvenile hormones.	
	<b>8.4</b> Other peptide and steroid hormones.	
9.	Insecticide degradation and detoxification.	3

- 1. Fundamentals of insect physiology, Blum N.S., John Wiley and sons, NY
- 2. An introduction to insect physiology, Bursell, e. academic press, NY
- Insect biochemistry and function Candy D.J. and Kilby D.A. Chapman and hall, London
- 4. Comprehensive insect physiology, biochemistry and pharmacology, Kerkut G.A and Gilbert L.I., Vol 1 to 13 Pergamon press, Oxford, NY
- 5. The Insects: Structure and Function. Forth ed., Chapman R. F. (1998), Cambridge University Press, UK.
- Insect Physiology. Prakash, M. (2008), Discovery Publishing House Pvt. Ltd., New Delhi.
- 7. Physiological Systems in Insects. Second ed., Klowden, Marc (2007), Elsevier, USA
- The Principles of Insect Physiology, Seventh ed. Wigglesworth, V.B. (1972), Chapman and Hall, London.

	ZOO 605 MJP : Laboratory Exercises in Animal Physiology – I								
Teaching Scheme Marking Scheme									
Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total		
Π	Ш	Major Core	02	01	15	35	50		

#### **Course Outcomes :**

After successfully completing this course, students will be able to :

- CO1: Understand the electro organs, their structure and function.
- CO2: Assess the effect of starvation on liver and muscle glycogen in given animal.
- CO3: Understand the effect of exercise on breathing, pulse rate and blood lactate level.
- CO4: Demonstrate the effect of pH, temperature and inhibitors on salivary amylase.

CO5: Map the taste buds on human tongue.

CO6: Understand different diseases of bone.

CO7: Estimate the blood alkaline and acid phosphatase.

CO8: Understand effect of adrenaline, acetylcholine and atropine on heart.

Sr No	Title of the Dreatical	Practical
SI. INU.		Assigned (P)
1.	Study of electro organs : structure and function.	1P
2.	Study of osmotic stress and volume change in earthworm.	1 <b>P</b>
3.	Study of digestive enzymes in the gut of cockroach. (Compulsory)	1 <b>P</b>
4.	Study of digestive enzyme from hepatopancreas of crab / liver of rat.	2P
5.	Estimation of the blood chloride in crab and acclimation to different osmotic concentrations. ( <b>Compulsory</b> )	2P
6.	Study of total RBC count.	1P
7.	Study of total WBC count and differential count of WBC. (Compulsory)	2P
8.	Estimation blood alkaline and acid phosphatase.	1P
9.	Estimation of salivary amylase and maltase. (Compulsory)	1P
10.	Absorption spectra of blood pigment.	1P
11.	Study of heart - Myogenic and neurogenic. (Compulsory)	1P
12.	Study of bone diseases – Osteoporosis & Rickets.	1P
13.	Study the effect of exercise in breathing rate, pulse rate and blood lactase in human.	1P
14.	Study the effect of adrenaline, acetylcholine and atropine on rat/crab heart.	2P
15.	Mapping of test area on human tongue. (Compulsory)	1 <b>P</b>

ZOO 605 MJP : Lab Exercises in Entomology - I								
	Teaching Scheme Marking Scheme							
Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total	

Π	III	Major Core	02	01	15	35	50

#### **Course Outcomes :**

After completing the course student will be able to :

- CO1: Understand different collection methods for collecting insects.
- CO2: Perform various insect preservation techniques for further study.
- CO3: Identify and classify insect orders with the help of their morphological features.
- CO4: Could dissect the insect to observe its body systems and can mount mouthparts, leg, wings, etc.
- CO5: Identify type of mouth parts, antenna, legs and wings of insects.
- CO6: Learn about head orientations, articulations, and appendages with respect to their functions.
- CO7: Know about insect abdominal appendages and their significance.
- CO8: The knowledge acquired and skill developed in the field of entomology will help in increasing farmer's income, better human health and decreased environmental pollution as well as meet out the future challenges in health and agricultural sectors.

Sr. No	Title of the Practical	Practical Assigned (P)
1.	Method of collection, preservation & presentation of insects.	2P
2.	Study of Taxonomy and diagnostic features up to family of Apterygote, Exopterygote and Endopterygote insects (at least one insect from each order). (Compulsory - 3)	6P
3.	Study of systematic position, habit, habitat and important morphological features of generalized insect – Grasshopper / Cockroach. (Compulsory)	2P
4.	Dissection of generalized insect (Grasshopper / Cockroach) so as to study its digestive and nervous systems. (Compulsory)	2P
5.	Dissection of generalized insect (Grasshopper / Cockroach) so as to study its reproductive system and retro-cerebral complex. (Compulsory)	2P

6.	Temporary mounting of mouth parts, antenna, legs, wings, spiracles and tympanum of a generalized insect. ( <b>Compulsory</b> )	1P
7.	Dissection of an insect pest (Plant bug or any insect pest as per local availability and legal permissibility) so as to study the taxonomy, diagnostic features and anatomy pertaining to digestive, nervous and reproductive systems.	3P
8.	Study of head capsule: Structure, head orientations and modifications. ( <b>Compulsory</b> )	1P
9.	Study of types of mouthparts and antennae. (Compulsory)	1P
10.	<ul><li>a) Study of general structure of legs and their modifications.</li><li>b) Study of general structure of a wing and its modifications.</li><li>(Compulsory)</li></ul>	2P
11.	Study of abdominal appendages.	1P
12.	Compulsory visit to Wildlife Sanctuary/ National Park/ Zoo. Preparation of report and submission.	3P

ZOO 605 MJP : Lab Exercises in Genetics - I								
Teaching Scheme Marking Scheme								
Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total	
II	III	Major Core	02	01	15	35	50	

#### **Course Outcomes :**

After completing the course student will be able to :

- CO1: Construction of pedigree and its application in genetic counseling.
- CO2: Introduce students to various databases and their importance.
- CO3: Hands-on experimentation of genetic crosses of *Drosophila* population as well as simulator software to understand the effect of evolutionary forces.
- CO4: Use of *Drosophila* as model organism to learn the various inheritance patterns through hands-on experiments.
- CO5: Induction and demonstration of heat shock proteins.
- CO6: Establishment and maintenance of bacterial culture and basic staining.

- CO7: Induction and demonstration of mutation in bacteria.
- CO8: Hands on experimentation of bacterial conjugation to understand gene transfer method.

Sr. No.	Title of the Practical	Practical Assigned (P)		
	Analysis of metric traits and estimation of phenotypic variance.	1100- <b>G</b> -100 (1)		
1.	(Compulsory)	1P		
	Partitioning of phenotypic variance in genetic and non-genetic			
2.	components in a simulated population. Estimation of DGD.	1P		
	(Compulsory)			
2	Detection of polymorphism in a population (Biochemical-	<b>AD</b>		
5.	enzyme).	2 <b>P</b>		
	To study population cage experiments using Drosophila :			
1	Experimental simulation and modelling.	10		
4.	A) Genetic Drift.			
	B) Artificial selection.			
	To study population cage experiments using Drosophila -			
5	Experimental simulation and modeling.			
5.	A) Mutation.	IP		
	B) Migration.			
(	Study of extraction of genomic DNA from Drosophila.	• •		
0.	(Compulsory)	2P		
7	Study agarose gel electrophoresis of genomic DNA of	•••		
/.	Drosophila.	2P		
Q	Study methodology for constructing human pedigree.	15		
0.	(Compulsory)	IP		
	Study analysis and construction of typical pedigree for AR, AD,			
9.	sex-linked recessive and sex linked dominant, mitochondrial	1P		
	inheritance patterns.			
10.	Study concept of genetic disorder databases.	1P		

11.	Demonstration of use of OMIM.	1P
12.	Study Puff induction in polytene chromosome in <i>Drosophila</i> / Induction and demonstration of heat shock proteins. (Compulsory)	2P
13.	Culture establishment and initiation, gram staining, and growth curve of any one - gram positive and gram negative bacteria. (Compulsory)	2P
14.	Study of growth curve of cultured bacteria and calculation of doubling time. ( <b>Compulsory</b> )	2P
15.	To estimate 1% U.V. survivorship rate in bacteria.	2P
16.	Study of culturing Antibiotic resistant donor bacteria strain and antibiotic susceptible bacteria. ( <b>Compulsory</b> )	2P
17.	Study of Bacterial gene (antibiotic resistance marker) transfer by conjugation.	2P
18.	Study of autosomal gene inheritance (monohybrid crosses and dihybrid crosses using vestigial and sepia mutants along with wild-type flies for F1 and F2 generations) and Chi-square analysis of data of progeny.	2P
19.	Study of morphological diversity– wing, sex comb, genital plate and bristles in <i>D. melanogaster</i> , <i>D. ananassae</i> , <i>D. nasuta</i> .	1P
20.	Study of population genetics problems. (Compulsory)	1P
21.	Study of genetic variation in natural population - beak shape, colour pattern in lady beetle, flower colour variation, mimicry- butterfly and orchid flowers, metroglyph analysis. ( <b>Compulsory</b> )	1P
22.	Culturing of <i>Drosophila</i> for isolation of female virgin flies. (Compulsory)	2P

ZOO 606 MJP : Laboratory Exercises in Physiology of Reproduction and Insect Physiology & Biochemistry							
Teaching Scheme Marking Scheme							
Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total

Π	III	Major Core	02	01	15	35	50
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#### **Course Outcomes :**

After completing the course student will be able to :

CO1: Understand anatomy and histology of male and female reproductive system in rat / mouse.

- CO2: Learn how to examine vaginal smears.
- CO3: Understand types of placenta and uterine muscles.
- CO4: Know about various contraceptive devices and their importance.
- CO5: Asses effect of temperature on water loss in Cockroach.
- CO6: Understand the role of amylase in Cockroach.
- CO7: Estimate oxygen consumption in dragon fly nymph.
- CO8: Understand the heart and haemocytes of Cockroach.
- CO9: Determine the trehalase activity in haemolymph of an insect.

#### **Detailed Syllabus :**

Minimum 7 practicals should be conducted from Physiology of Reproduction and 8 practicals from Insect Physiology & Biochemistry.

Sr. No	Title of the Practical	Practical Assigned (P)
1.	Study of anatomy of male and female reproductive system in rat / mouse. (Compulsory)	1P
2.	Study of histological slides of male reproductive organs -Testis, Vas deferens, Epididymis, Prostate, Seminal vesicle, Cowper's gland. ( <b>Compulsory</b> )	2P
3.	Study of histological slides of female reproductive organs - Ovary, Uterus, fallopian tube. ( <b>Compulsory</b> )	1P
4.	Study of Vaginal smear technique in Rat.	1P
5.	Study of placental types. (Compulsory)	1P
6.	Study of Uterine smooth muscles.	1P
7.	Study of contraceptive devices. (Compulsory)	1P
8.	Visit to artificial insemination Centre and family planning centre.	2P

	Insect Physiology & Biochemistry	
1.	Estimation of amylase in midgut of Cockroach.	1P
2.	Study the effect of temperature on water loss in Cockroach.	1P
3.	Perform Von Wisselinghs test for presence of chitin in insect cuticle. ( <b>Compulsory</b> )	1P
4.	Estimation of Oxygen consumption in dragon fly nymph. ( <b>Compulsory</b> )	2P
5.	Estimation of Amino acid in haemolymph of any insect by chromatographic technique.	2P
6.	Study of fat body glycogen of cockroach and effect of starvation.	1P
7.	Study of heart and haemocytes of Cockroach. (Compulsory)	1P
8.	Determination of the trehalase activity in haemolymph of any insect.	1P

	ZOO 607 MJ : Applied Genetics								
Teaching Scheme					Mar	king Scheme			
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total		
Π	IV	Major Elective	02	02	15	35	50		

#### **Course Outcomes:**

After completing the course student will be able to :

- CO1: The students will learn the process of isolation of gene.
- CO2: Explain the different genome project with their significance.
- CO3: Able to solve the pedigree analysis.
- CO4: Explain the DNA fingerprinting, Gene and stem therapy technique.
- CO5: The student will be able to understand the technique of microbial genetics.
- CO6: The students learn the types and applications of molecular markers.
- CO7: Understand the somatic cell genetics.
- CO8: The student will be aware about the genetic counseling.

#### **Detailed Syllabus :**

		Lectures
Sr. No.	Topics	Allotted
		(L)
1	Genetic engineering : objectives, tools, gene cloning and gene	4
1.	isolation.	•
2	Genomics : scope and importance, genome projects- E. coli, yeast,	4
4.	Drosophila and human.	7
3.	Human genetic diseases : types, pedigree analysis, inheritance	6
	patterns, diagnosis – non invasive and invasive method.	U
4	Methods and applications of DNA fingerprinting, gene therapy, stem	3
т.	cell therapy.	5
5.	Genetic counselling and DNA barcoding.	2
6	Microbial genetics : methods of genetic transfers – transformation,	3
0.	conjugation, transduction.	5
	Molecular markers : types of molecular markers , applications in	
7.	discerning polymorphism, germplasm characterization, gene	6
	tagging, disease diagnostics.	
8.	Somatic cell genetics and its applications.	2

#### **Suggested Readings:**

- Concepts of Genetics. William S Klug and Michael R Cummings. 10<sup>th</sup> edition. Pearson education India. (2016).
- 2. Lewin, Benjamin. Genes IX. John Wiley and Sons, New York, 2008.
- 3. Gene cloning: An introduction. Chapman and Hall, London. Brown, T. A. 1995.
- Recombinant DNA and biotechnology. Kreuzer, H. and A. Massey. 2001. ASM press. Washington D. C.
- 5. Genetics by Gupta, PK., Rastogi Publication, Meerut.

ZOO 608 MJP : Laboratory Exercises in Applied Genetics		
Teaching Scheme	Marking Scheme	

Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total
п	III	Major Elective	02	01	15	35	50

#### **Course Outcomes:**

After completing the course student will be able to :

- CO1: The course gives detailed idea about applications of genetics in different areas.
- CO2: To understand genetic engineering and its tools, components involved in cloning and recombinant gene technology.
- CO3: Understand the importance of techniques employed in genetic engineering and to familiarize the students with the application of genetic engineering to meet the current demands.

CO4: To study various classical cytogenetic techniques used in advanced diagnostic methods.

CO5: Concept of molecular medicine and molecular diagnostic methods.

CO6: Construct a pedigree and its application in genetic counselling.

CO7: Culture the bacteria for various studies.

CO8: Know about bioinformatics databases.

Sr. No	Title of the Practical	Practical Assigned (P)
1.	Isolation of WBCs by Ficoll-Paque media. (Compulsory)	2P
2.	Study the induction technique of human leukocyte culture. (Compulsory)	2P
3.	Preparation of human chromosomes and G banding from cultured leukocyte. (Compulsory)	2P
4.	Preparation of human chromosomes and C banding from cultured leukocyte.	2P
5.	Culturing and preparation of competent bacterial cells. (Compulsory)	2P
6.	Transformation induction and screening recombinant bacteria by blue white screening method. (Kit method) ( <b>Compulsory</b> )	2P
7.	Culturing of bacteria for restriction endonuclease digestion (Kit method).	2P
8.	Mapping of restricted endonuclease digested DNA from cultured bacteria (Kit method).	2P

9.	Study of case history from (ref books) for genetic counseling using pedigree analysis. ( <b>Compulsory</b> )	1P
10.	Study of sex chromatin in humans by histological staining. (Compulsory)	1P
11.	Study of Bioinformatics databases in genetic engineering.	1P
12.	Analysis of DNA and amino acid sequence by BLASTA and FASTA.	1P
13.	A compulsory visit to IVF center / Animal breeding center and report writing.	3P

ZOO 609 MJ : Animal Behaviour								
Teaching Scheme					Mar	king Scheme		
Year	Semester	Course Type	Credits	Lectures per week	Continuous Internal Assessment	End Semester Examination	Total	
Π	ш	Major Elective	02	02	15	35	50	

#### **Course Outcomes:**

After completing the course student will be able to :

- CO1: Define animal behaviour as the actions living things carry out to survive and reproduce.
- CO2: Use concepts of animal behaviour to understand human behaviour.
- CO3: Understand the ecological aspects of animal behaviour.
- CO4: Know about the strategies of organization in animals and their interactions.
- CO5: Understand the reproductive behaviour of animals.
- CO6: Learn how animals communicate with each other.
- CO7: Understand about the modes of parental caring in various animals.
- CO8: Know about the extraordinary phenomenon defence mimicry and camouflage.

		Lectures
Sr. No.	Торіс	Assigned
		(L)
1.	Introduction to animal behaviour :	3

	<b>1.1</b> Innate behaviour, learning, reasoning, motivation, conflict and	
	sexual behaviour.	
	<b>1.2</b> Migration and homing with special reference to birds.	
	Ecological aspects of behaviour :	
	<b>2.1</b> Habitat selection.	Λ
2.	<b>2.2</b> Food selection and optimal foraging theory.	4
	3.3 Anti-predator defence mechanisms, aggression, territoriality	
	and dispersal.	
	Social behaviour :	
	<b>3.1</b> Aggregations - schooling in fishes, flocking in birds, herding	
3.	in mammals.	6
	3.2 Group selection, kin selection, altruism, inclusive fitness, and	
	social organization in insects and primates.	
	Reproductive behaviour :	
	<b>4.1</b> Evolution of sex.	
1	<b>4.2</b> Reproductive strategies.	7
т.	<b>4.3</b> Mating systems.	
	<b>4.4</b> Courtship, sperm competition.	
	<b>4.5</b> Sexual selection.	
	Parental care :	
5	<b>5.1</b> Parental and alloparental behaviour.	4
J.	<b>5.2</b> Cooperative breeding.	-
	<b>5.3</b> Family systems.	
	Communication in animals :	
	<b>6.1</b> Visual.	
6.	6.2 Olfactory - Hormones and behaviour, pheromones and	4
	behaviour.	
	<b>6.3</b> Auditory and tactile.	
7.	Camouflage and mimicry - Types of mimicry.	2

 Animal Behavior, an Evolutionary Approach, 8th Edition, Alcock, J., Sinauer Associate, Inc. Publishers, Sunderland, Massachusetts, USA.  Principals of Animal Behavior, 3rd edition, Dugatkin, L.A., W.W. Norton & Company, 2009.

ZOO 610 MJP : Laboratory Exercises in Animal Behaviour							
Teaching Scheme				Marking Scheme			
Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total
II	III	Major Elective	02	01	15	35	50

#### **Course Outcomes :**

After completion of the course student will be able to :

CO1: Learn how phototaxis and chemotaxis brings about changes in Drosophila behaviour.

- CO2: Record the behaviour of human in the absence of visual cues.
- CO3: Assess the stress developed during social situations.
- CO4: Perform different test to record human social behaviour.
- CO5: Analyse the stress conditions during Maze test.
- CO6: Learn to record and interpret behaviour of animals in the field.
- CO7: Understand how birds interact with each other with the help of vocal cues.
- CO8: Organize field works and nature trail.

Sr. No.	Title of the Practical	Practical Assigned (P)
1.	Study of <i>Drosophila</i> : phototaxis and chemotaxis.	2P
2.	Study of navigation in the absence of visual cues.	1P
3.	Study of stress in social situations.	2P
4.	Study of human social behaviour. (Compulsory)	2 <b>P</b>
5.	Constructing an ethogram habituation in snails.	1P
6.	Study of Human mate choice.	1P

7.	<ul><li>Field observations to record animal behaviour of Amphibians /</li><li>Birds/ Mammals with the help of Scan and Focal sampling.</li><li>(Compulsory)</li></ul>	2P
8.	Studying the vocal interactions of birds at artificial feeding stations.	2P
9.	Studies on Predator - Prey interaction - Recognition of predators by prey using amphibian tadpoles.	2P
10.	Compulsory visit to any Zoo / Rescue Centre / Animal Welfare NGO and report writing. (Compulsory)	3P

ZOO 611 RP : Research Project								
Teaching Scheme				Marking Scheme				
Year	Semester	Course Type	Credits	Practical per week	Continuous Internal Assessment	End Semester Examination	Total	
п	III	Research Project	04	02	30	70	100	

**Objectives :** The objective of the course is to develop the research skills, advanced techniques, and critical analysis of the students.

**Learning outcomes:** Students will acquire basic skills in designing & handling research experiments and writing a project report that will help them to be independent researchers.

#### Planning and implementation :

- III semester project work is distributed to students at the beginning of second year and student should complete this at the end of III semester.
- The student plans and implements projects independently through the understanding and learning of various research tools and techniques. During the dissertation, students learn to write a dissertation, research article and project for the benefit of the future.

#### **Project report / dissertation:**

- At the end of the project, students are instructed to write a dissertation which provides complete information about the research work.
- The evaluation of the project report and Viva voce is an open defence type through a power point presentation and is evaluated by an external examiners.

#### **Structure of a Research Project :**

There will be main sections for a research project, these are:

- Title page
- Acknowledgements
- Abstract
- Main text
  - 1. Introduction about the aims of the project and what you hope to achieve.
  - 2. Aims & objectives.
  - 3. Hypothesis to be tested.
  - 4. Literature review evaluating and reviewing existing knowledge on the topic.
  - 5. Methodology the methods which will be used for your primary research.
  - 6. Findings and results presenting the data from your primary research.
  - **7. Discussion** summarising and analysing your research and what you have found out.
  - 8. Conclusion how the project went (successes and failures), areas for future study.
  - **9.** List of references correctly cited sources that have been used throughout the project.
  - **10. Appendices** Present the raw data in the form of graphs and tables that are referred to in the report. Each appendix should have an identifying number or letter and a heading.

#### Length of a Project Report :

The length of a research project will depend on the study level and the nature of the subject. There is no defined length for research project dissertation, however the average dissertation style essay can be between 40 to 50 pages.

#### Academic Integrity Policy :

Written or other work that students submit must be a product of their individual effort (unless it is an assigned group project) and must be consistent with appropriate standards of professional ethics. Academic dishonesty, which includes plagiarism, cheating, and other forms of dishonest behavior, is strictly prohibited.

<u>Grade / Work distribution</u>: Semester work and grade distribution in percentages for the III semester of the research project is 30 % Internal evaluation & 70 % External evaluation.

#### Evaluation of the interim report of the project work:

### A) Internal evaluation : 30%

Background of the problem & Review of Literature = 10 Marks

Visits / Lab. Work = 10 Marks

Log Book = 10 Marks

#### Total = 30 Marks

#### **B)** External Evaluation : 70%

Project work = 40 Marks Disertation & evidences / proofs = 10 Marks Power Point Presentation and Viva Voce = 20 Marks Total = 70 Marks

**GRAND TOTAL = 100 MARKS**