



Fergusson College (Autonomous) Pune

**Learning Outcomes-Based Curriculum
for
F. Y. B. Sc. Zoology**

With effect from June 2019

Program Outcomes (POs) for B.Sc. Programme

PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of an graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	Social competence: Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	Academic competence: (i) Develop deeper understanding of key concepts of Zoology at biochemical, molecular, cellular, physiological, histological and systematic level. (ii) Understand the ecological impact on the evolutionary history of not only mankind but also unfolding the secrets of origin of life and classical Zoology. (iii) Assess environmental impact on applied and skill-based branches of Zoology
PSO2	Personal and Professional Competence: (i) Carry out analysis of biological data, perform laboratory procedure with suitable technique in Histology, Physiology, Immunology, Bio- chemistry, molecular biology, environment biology, organic evolution, animal pathology, Endocrinology and biological techniques. (ii) Identify animals on the basis of comparative morphology and anatomy.
PSO3	Research Competence (i) Integrate and explore biological data. (ii) Use current laboratory setup, instrumentation, statistical and biological techniques in the collection, organization, analysis, interpretation and manipulating the data related to Zoology discipline and allied branches. (iii) Identify and interpret research literature, formulate ideas, write reports and review articles related to the subject.
PSO4	Entrepreneurial and Social competence: (i) Empower the students by enhancing their self-sustainability capabilities through a thorough understanding of skill-based subjects and techniques by learning (ii) culturing techniques of economically important animals in applied and classical zoology. (iii) Develop social competence including listening, speaking, observational, effective interactive skills and presenting skills to meet global competencies.

Programme Structure

Year	Course Code	Course Title	Credits
F. Y. B. Sc.	Semester I		
	ZOO1101	Life and diversity of animals - I	2
	ZOO1102	Cell Biology	2
	ZOO1103	Zoology Practical - I	2
	Semester II		
	ZOO1201	Life and diversity of animals - II	2
	ZOO1202	Principles of Genetics	2
	ZOO1203	Zoology Practical - II	2

Year	Name of Paper	Paper Code	Title of Paper	No. of Credits
S.Y. B.Sc.	Semester III			
	Theory Paper - 1	ZOO2301	Life and diversity of animals - III	3
	Theory Paper – 2	ZOO2302	Economic zoology-I	3
	Practical	ZOO2303	Practical	2
	Semester IV			
	Theory Paper – 1	ZOO2401	Life and diversity of animals - IV	3
	Theory Paper – 2	ZOO2402	Economic Zoology-II	3
	Practical	ZOO2403	Practical	2

Year	Paper No.	Course code	Title	Credits	CE maximum Marks	ESE maximum Marks	Total maximum Marks
T. Y. B. Sc.	Semester V						
	DSE-1A	ZOO3501	Life and Diversity of Animals-V	2	50	50	100
	DSE-1B	ZOO3502	Fundamentals of Histology	2	50	50	100
	DSE-2A	ZOO3503	Biochemistry	2	50	50	100
	DSE-2B	ZOO3504	Ecology and Environmental Biology	2	50	50	100
	DSE-3A	ZOO3515	Immunology	2	50	50	100
	OR						
	DSE-3B	ZOO3506	Insect Pest Management	2	50	50	100
	DSE-1	ZOO3517	Biological Techniques and Bioinformatics	2	50	50	100
	OR						
	DSE-2	ZOO3508	Forensic Entomology	2	50	50	100
	SEC-1*	ZOO3509	Bee Keeping.	2	50	50	100
	SEC-2*	ZOO3510	Vermiculture and Vermicomposting	2	50	50	100
	DSE-1	ZOO3511	Zoology Practical-I	2	50	50	100
	DSE-2	ZOO3512	Zoology Practical-II	2	50	50	100
	DSE-3	ZOO3513	Zoology Practical-III	2	50	50	100
	Semester VI						
	DSE-4A	ZOO3601	Life and Diversity of Animals-VI	2	50	50	100
	DSE-4B	ZOO3602	Physiology - Life Sustaining Process	2	50	50	100
	DSE-5A	ZOO3603	Molecular Biology	2	50	50	100
	DSE-5B	ZOO3604	Organic Evolution	2	50	50	100
	DSE-6A	ZOO3605	Animal Pathology	2	50	50	100
	OR						
	DSE-6B	ZOO3606	Human Genetics	2	50	50	100
	DSE-7A	ZOO3617	General Endocrinology	2	50	50	100
	OR						
	DEC-7B	ZOO3608	Poultry Science	2	50	50	100
	SEC-3*	ZOO3609	Biostatistics	2	50	50	100
	SEC-4*	ZOO3610	Public health and Hygiene	2	50	50	100
	DSE-1	ZOO3611	Zoology Practical-IV	2	50	50	100
	DSE-2	ZOO3612	Zoology Practical-V	2	50	50	100
	DSE-3	ZOO3613	Zoology Practical-VI	2	50	50	100

F.Y. B.Sc. Semester I		
Title of the Course and Course Code	Life and Diversity of Animals – I ZOO1101	Number of Credits : 02
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define terms related to animal systematics and outline the various systems of classification.	
CO2	Outline the names of protozoan and helminthes parasites of animals and illustrate their life cycles and pathogenicity.	
CO3	Demonstrate the structure and functions of spicule of sponges and classify the sponges on the basis of their skeleton.	
CO4	Explain the systematic position, habitat, body wall, coelom of earthworm and explain the structure and functions of their organ system.	
CO5	Classify the invertebrates on the basis of comparative morphology of animals and justify the reasons.	
CO6	Write the field report on the basis of comparative morphology of animals by conducting the field survey.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Principles of classification: Origin, development and Definition of systematics, Systematics-Linnaean hierarchy, Binomial nomenclature, Six kingdom classification system	4
II	Outline of classification with salient features of the following phyla: (up to class with one example) 2.1 Protozoa Porifera, Coelenterata (Cnidaria), Platyhelminthes., Aschelminthes.	6
III	General topics: Protozoan diseases; (Life cycle, pathogenicity, treatment and prevention of Plasmodium and <i>Entamoeba</i>), Skeleton in Sponges; Reproduction in Sponges, Life cycle and pathogenicity of <i>Taenia</i> , <i>Ascaris</i> and <i>Fasciola hepatica</i> .	12
IV	Study of Earthworm: Systematic position, Habits and habitat, External characters Digestive system, Circulatory system, Nervous system and sense organs, Excretory system, Reproductive system, Economic importance (vermicompost).	14

References:

1. Life of Vertebrates by Young, JZ., III Edition, Clarendon Press, London
2. General Zoology by Goodnight and others IBH Publishing Co.
3. Invertebrate zoology By Jordan EL., and Verma PS., S.Chand and Co., New Delhi
4. Textbook of Invertebrate Zoology, By Kotpal, RL., Rastogi and Co. Meerut
5. Phylum Protozoa By Kotpal, RL., Rastogi and Co. Meerut
6. Phylum Porifera By Kotpal, RL., Rastogi and Co. Meerut
7. Phylum Coelenterates By Kotpal, RL., Rastogi and Co. Meerut
8. Phylum Helminthes By Kotpal, RL., Rastogi and Co. Meerut
9. Phylum Annelida By Kotpal, RL., Rastogi and Co. Meerut
10. Life of Invertebrates by Prasad, ASN, Vikas Publishing House, New Delhi
11. Zoology by S.A. Miller and J.P. Harley - The McGraw Hill Co.

Title of the Course and Course Code	Cell Biology ZOO1102	Number of Credits : 02
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe the concept of cell theory, cell-cell signalling, apoptosis, oncogenes and proto-oncogenes. Recall types of cells and label its components.	
CO2	Differentiate plant cell, animal cell and compare their properties. Explain the structure and functions of various cell organelles and the process of cell division.	
CO3	Illustrate the mechanism of programmed cell death, cell to cell communication and the process of mitosis and meiosis.	
CO4	Identify and draw diagrams of cell organelles and analyse their functions.	
CO5	Review the process of apoptosis, cell cycle, characteristics of cancerous cells.	
CO6	Integrate the postulates of the cell theory with cellular activities which leads to repairing and regeneration of the cells and the production of energy.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Introduction to cell biology Definition and scope of cell Biology, Introduction to cell theory.	02
II	Types of cells Organization of prokaryotic cell (<i>E. coli</i>) and eukaryotic cell (Plant and Animal).	02
III	Cell membrane Organization of cell membrane: Fluid Mosaic Model, Chemical composition of cell membrane, Functions of cell membrane	05

IV	Cytoplasm Chemical composition and properties of cytoplasm, Cytoskeleton & ECM: Structure and Organization of Actin and Myosine filaments, Microtubules and Intermediate Filaments, Cell Movement.	04
V	Study of cell organelles with respect to structure and functions. Endoplasmic reticulum, Golgi apparatus, Mitochondria, Lysosomes, peroxisomes and glyoxysomes, Ribosomes	12
VI	Nucleus Shape, size, number and position, Ultra structure of nucleus, Functions of nucleus	03
VII	Cell division and its significance Cell cycle, Mitosis, Meiosis	04
VIII	General Topics Cell - cell signalling: apocrine, paracrine, endocrine, Apoptosis and its significance, Cancer cell: introduction, characteristics, proto-oncogene and oncogene.	04

References:

1. Cell Biology By Powar CB, Himalaya Publication House 25.
2. Cell and Molecular Biology By Dupraw I, Academic Press, New York 26.
3. Cell Biology By Avers, C.J., Addison Wesley Pub. Co. New York and London 27.
4. Cell and Molecular Biology By Carp, G., John Wiley, USA 28.
5. Cell Biology By David, E., Sadava, Johnes and Bartlett Publication, London 29.
6. Cell Structure and Function By Lowey, A.G. and Siekevitz, J.R., Menninger and Gallew, J.A.N., Saunders College Publication, Philadelphia
7. The Cell by G.M. Cooper - Sinauer Associate Inc

Title of the Course and Course Code	Zoology Practical – I ZOO1103	Number of Credits : 02
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe fundamental concepts of systematics, cell division and standard operating procedures of compound microscope.	
CO2	Classify different species of animals from protozoa, porifera, coelenterate, platyhelminthes and aschelminthes.	
CO3	Demonstrate the procedure of detection of mitochondria, preparation of slide for mitosis and identify various stages of mitosis.	
CO4	Differentiate the features of prokaryotic and eukaryotic cells and compare plant cell and animal cell.	
CO5	Justify the identification and classification of animals with the help of their distinguishing features.	
CO6	Compile the data obtained from observations of animals in the field and organize it as per animal systematics.	

Sr. No.	Title of Experiment/ Practical
1	To study the classification with reasons of the following (D) Phylum Protozoa- <i>Paramecium</i> , <i>Amoeba</i> and <i>Euglena</i> Phylum Porifera- <i>Sycon</i> , <i>Hyalonema</i> and <i>Euspongia</i> Phylum Coelenterata (Cnidaria) - <i>Hydra</i> , <i>Sea anemone</i> and <i>Phylasia</i>
2	Phylum Platyhelminthes- <i>Planaria</i> , <i>Schistosoma</i> and <i>Echinococcus</i> Phylum Aschelminthes- <i>Ancylostoma</i> , <i>Trichinella</i> and <i>Wuchereria</i> .
3	To study the life cycle of following (D) <i>Taeniasolium</i> , <i>Fasciola hepatica</i> , <i>Ascaris lumbricoides</i> .
4	Temporary preparation of spicules from persevered sponge, Study of permanent slide of gemmule. (E)
5	Study of prokaryotic and eukaryotic cell with the help of permanent slide/ picture/model/chart. (D)
6	Study of Cell organelles (Mitochondria, Endoplasmic reticulum, Golgi complex) with the help of electron microscopic photograph/ picture/ model/ chart (D)
7	Study of different mitotic stages in onion root tips. (E)

8	Detection of mitochondria from onion peeling by Janus Green staining. (E)
9	Identification and classification of animals from Fergusson College campus to create awareness about the conservation of animals (any Five). (ABL)
10	Standard operating procedures of a compound microscope (ABL)

F.Y. B.Sc. Semester II		
Title of the Course and Course Code	Life and Diversity of Animals - II ZOO1201	Number of Credits : 02
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Describe the terms related to chordate taxonomy.	
CO2	Classify and compare the characters of subphyla of protochordates. Explain the characters of classes of pisces and amphibians.	
CO3	Demonstrate the various systems of frogs and describe its organ system.	
CO4	Classify the vertebrate fauna on the basis of shared homologous characters.	
CO5	Compare the types of scales in fishes and explain parental care in Amphibian.	
CO6	Collect the information and write about neoteny in Amphibia.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	General characters of Chordates and classification of chordates up to class.	04
II	General characters and classification of following subphyla upto class with one example. Hemichordata, Urochordata and Cephalochordata	04
III	Salient features and classification with one example of the following: Cyclostomata (up to order), Pisces- (Chondrichthyes and Osteichthyes fishes), Amphibia. (up to order)	04
IV	Study of Frog: Systematic position, Habit and habitat, External characters and sexual dimorphism, Digestive system, food, feeding and physiology of digestion, Respiratory system, Circulatory system (excluding lymphatic system), Central Nervous system, Sense organs, Reproductive systems.	18
V	General topics: Types of scales in fishes, Parental care in Amphibians, Neoteny in Amphibia.	06

References:

1. The Frog-its reproduction and development -By Robert Rugh,TataMcGraw HillEdition,New Delhi
2. Biology of Animals by Ganguly, B. B., Sinha, A. K., Adhikari, S., New Central Book Agency, Kolkata
3. Introduction to Amphibia By Bhamrah, M. S., Juneja, K., Anmol Publication, Delhi
4. Life of Vertebrates by Young, J. Z., III Edition, Clarendon Press, London
5. General Zoology by Goodnight and others IBH Publishing Co.
6. Life of Vertebrates by Young, J. Z., III Edition, Clarendon Press, London
7. General Zoology by Goodnight and others IBH Publishing Co.
8. Textbook of Vertebrate Zoology, by Kotpal, R. L., Rastogi and Co. Meerut
9. Animal Diversity by Kershaw, D. R., Redwood Burn Ltd., Trowbridge
10. Textbook of Zoology by Parkar J. and Haswell, W., ELBS Edition
11. Textbook of Zoology by Vidyarthi, Agrasia Publishers, Agra
12. Chordate Zoology by Jorden E. L., and Verma P. S., S. Chand and Co., New Delhi
13. Functional Organization of Chordates (Part I and II) by Nigam H. C. and Sobti, R., S. Chand and Co., New Delhi.

Principles of Genetics ZOO1202		
Title of the Course and Course Code		Number of Credits : 02
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Define different terminology of the genetics. Describe the concepts of Genetics, gene interaction, lethal genes, euploidy, aneuploidy, sex linked inheritance and principles of inheritance.	
CO2	Explain and differentiate between multiple alleles and multiple genes. Explain the pattern of inheritance of complementary, supplementary, inhibitory and duplicate factors.	
CO3	Execute the crosses of sex-linked inheritance, inheritance of blood groups, monohybrid cross, dihybrid cross and the test cross..	
CO4	Differentiate the autosomes and sex chromosomes, euchromatin and heterochromatin. Outline the cell cycle of <i>Drosophila melanogaster</i> .	
CO5	Apprise structural and numerical aberrations of chromosomes and give their characteristics and examples.	
CO6	Specify the importance of genetic basis of life, integrate the principles of inheritance with plant and animal breeding and the medicolegal importance of blood group studies.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	Introduction to genetics and Mendelian Principles: Definition and concept of Genetics, Law of Dominance, Principle of Segregation, Principles of Independent Assortment, Test cross and Back cross	05
II	Gene Interaction and lethality: Concept of gene interaction, Allelic gene interaction (co-dominance and incomplete dominance) Non allelic gene interaction (Complementary factor, Supplementary Factor, Inhibitory factor, Duplicate dominant factor), Lethal genes in Mice(<i>Mus musculus</i>)	06
III	Multiple Alleles: Concept, characteristics and importance of multiples alleles, ABO blood group system & Rh-factor, incompatibility of Rh factor and medico-legal importance of blood group system. Concept of polygenic inheritance with reference to skin colour in human being	04
IV	Chromosomes: Morphological and molecular organization of chromosomes. Types of chromosomes: Autosomes, sex chromosomes and giant chromosomes (Lampbrush and polytene chromosomes). Chromosomal aberrations: structural changes and numerical changes: Autosomal Syndromes-Down's (Mongolism), Patau's, Edward's and Cri-du-chat, Sex chromosomal Syndromes -Klinefelter's and Turner's syndrome.	11
V	Study of Fruit fly (<i>Drosophila melanogaster</i>): Morphology and sexual dimorphism, Life cycle, Mutants: eye, wings and body colour (Two mutants of each type), Sex linkage.	04
VI	Human genetics: Study of human karyotype, Inborn errors of metabolism (albinism, phenylketonuria (PKU) and alkaptonuria), Somatic cell hybridization.	04
VII	Sex linked inheritance in human being: Inheritance of Colour-blindness, haemophilia and hypertrichosis., Deleterious recessive sex linked gene - congenital hyperuricemia (Lesch-Nyhan syndrome) and Duchenne- type Muscular Dystrophy	02

References:

1. Genetics by Karvita B. Ahluwalia, New Age International Publishers, New Delhi.
2. Genetics by Monroe W. Strickberger, Macmillan, New York
3. Genetics by Verma, P. S. And Agrawal, V. K., S. Chand and Co., New Delhi.
4. Principle of Genetics By Sinnott, Dunn and Dobzhansky, Tata McGraw Hill Edition, New Delhi.
5. Genetics by Gupta, P. K., Rastogi Publication, Meerut.
6. Genetics by Sarin, C., Tata McGraw Hill, New Delhi.
7. Principles of Genetics by Gardner, E. J., Simmons, M. J. and Snustad, D. P. John Wiley and Sons.
8. Genetics by B. D. Singh, Kalyani Publishers, Ludhiana.

Title of the Course and Course Code	Zoology Practical – II ZOO1203	Number of Credits : 02
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Recall the fundamental concepts of systematics, genetics, sex linked inheritance, multiple alleles and mutation.	
CO2	Discuss, identify and classify different species of animals from Hemichordata, Cephalochordata, Urochordata, Cyclostomata, cartilaginous fishes and Bony fishes	
CO3	Examine different genetic traits in human being and analyze the human karyotype.	
CO4	Detect A, B, AB, O and Rh blood groups.	
CO5	Appraise and classify the specimens from zoology museum.	
CO6	Compile the data of different syndromes in human beings and prepare a report.	

Sr. No.	Title of Experiment / Practical
1	To study the classification with reasons of the following; (D)Hemichordata- <i>Balanoglossus</i> Urochordata- <i>Doliolum</i> and <i>Herdmania</i> Cephalochordata- <i>Amphioxus</i> Cyclostomata- <i>Petromyzon</i> and <i>Myxine</i> Cartilaginous fishes- <i>Scoliodon</i> and <i>Sting ray</i> Bony fishes- <i>Labeo</i> and <i>Promphret</i>
2	Study of external characters, sexual dimorphism and digestive system of Frog with the help of preserved specimen/ model/ charts (D)
3	Study of brain of Frog with the help preserved specimen/ model/ charts. (D)
4	Temporary preparation of placoid and cycloid / ctenoid scales from preserved fishes. (E)
5	Study of <i>Drosophila</i> : External characters, sexual dimorphism and mutants (any

	two eye and any two wing mutants) (D)
6	Study of genetic traits in human beings (Rolling tongue, Widow's peak, Ear lobes, Colour blindness and PTC tasters / non tasters) (E)
7	Study of normal human karyotype from metaphase chromosomal spread picture (E)
8	Study of human blood groups (ABO and Rh- factor) (E)
9	Description and classification of specimens from Zoology Museum of Fergusson College (any Five). (ABL)
10	Study of genetic disorders from human population (any two). (ABL)