



Fergusson College (Autonomous) Pune

Learning Outcomes-Based Curriculum

for

F. Y. B. Sc. Zoology

With effect from June 2019

Programme Structure

Year	Semester	Course Code	Course Title	Credits	
F. Y. B. Sc.	I	ZOO1101	Life and diversity of animals - I	2	
		ZOO1102	Cell Biology	2	
		ZOO1103	Zoology Practical - I	2	
	II	ZOO1201	Life and diversity of animals - II	2	
		ZOO1202	Principles of Genetics	2	
		ZOO1203	Zoology Practical - II	2	
S. Y. B. Sc.	III	ZOO2301	Life and diversity of animals - III	3	
		ZOO2302	Economic zoology-I	3	
		ZOO2303	Practical	2	
	IV	ZOO2401	Life and diversity of animals - IV	3	
		ZOO2402	Economic Zoology-II	3	
		ZOO2403	Practical	2	
T. Y. B. Sc.	V	ZOO3501	Life & Diversity of Animals - V	3	
		ZOO3502	Fundamentals of Histology	3	
		ZOO3503	Bio-Chemistry	3	
		ZOO3504	Ecology and Environmental Biology	3	
		ZOO3505	Immunology	3	
		OR			
		ZOO3506	Insect Pest Management	3	
		ZOO3507	Biological Techniques & Bioinformatics.	3	
		OR			
		ZOO3508	Forensic Entomology	3	
		ZOO3511	Zoology Practicals - I	2	
		ZOO3512	Zoology Practicals - II	2	
	ZOO3513	Zoology Practicals - III	2		
	VI	ZOO3601	Life and Diversity of Animals - VI	3	
		ZOO3602	Physiology: Life Sustaining Processes	3	
		ZOO3603	Molecular Biology	3	
		ZOO3604	Organic Evolution	3	
		ZOO3605	Animal Pathology	3	
		OR			
		ZOO3606	Human Genetics	3	
		ZOO3607	General Endocrinology	3	
		OR			
		ZOO3608	Poultry Science	3	
		ZOO3611	Zoology Practicals - IV	2	
ZOO3612		Zoology Practicals - V	2		
ZOO3613	Zoology Practicals - VI	2			

Programme Outcome

PO1	The entire programme is learner centric and provides an open learning platform and help students in their journey towards variety of careers in biological sciences
PO2	The core subjects focus on basics of zoology like animal systematic, diversity, ecology and evolution in particular and help in gaining domain knowledge of the subject.
PO3	The electives provide an open learning environment where additional / domain related aspects could be offered which may include recent trends in the subject like biological techniques, Immunological techniques and computational skills.
PO4	Understanding basic and applied aspects of zoology like fisheries and apiculture
PO5	Learning basic human physiology and basic principles of Genetics
PO5	Understanding and learning of basic instrumentation in biology laboratory and knowledge of application of techniques for instrumentation.

PAPER CODE: ZOO1101

PAPER - I: Life and Diversity of Animals - I
Credits - 2C

Course Outcome	Teaching Pedagogy
Students completing the course of Life and Diversity of Animal - I will be able to identify and classify various animals.	Use of museum specimens, charts and models along with field work. For better understanding of classification besides black board method and ICT teacher shows slides and specimens.
After understanding various aspects of classification, students will be able to understand about morphological, anatomical characters and evolutionary aspects.	Use of museum specimens for comparative study.
Students will be able to understand the skeletal structure and process of reproduction in Sponges.	For teaching reproduction and skeleton in sponges, teachers use black board method and ICT in class room. In addition teachers show specimens of sponges and microscopic slides of gemmules and spicules.
Students will also understand the location, structure and functions of various systems and economic importance of earthworm as representative of invertebrates.	For teaching Earthworm in class room, teachers use black board method and ICT. Teachers show models, permanent slides and preserved dissected specimens of earthworm.
Students can apply their knowledge in vermi-composting and organic farming.	Use of Power point presentation showing techniques of vermi composting.
Students will be able to understand life cycle of protozoan parasites pathogenicity and control measures.	To teach protozoans parasites and diseases caused by them teacher uses black board method and ICT. For better understanding teacher show microscopic slides of different life stages of protozoan parasites in laboratory.
Students will able to understand diseases caused by helminth parasite, mode of transmission as well as their control measures.	Use of microscopic slides of different life stages and specimens of helminth parasites.

	Title and Contents	No. of Lectures
Unit - I	Principles of classification: 1.1 Origin, development and Definition of systematics 1.2 Systematics-Linnaean hierarchy. 1.3 Binomial nomenclature 1.4 Six kingdom classification system	4

Unit - II	Outline of classification with salient features of the following phyla: (up to class with one example) 2.1 Protozoa 2.2 Porifera 2.3 Coelenterata (Cnidaria) 2.4 Platyhelminthes. 2.5 Aschelminthes.	06
Unit - III	General topics: 3.1 Protozoan diseases; (Life cycle, pathogenicity , treatment and prevention of <i>Plasmodium</i> and <i>Entamoeba</i>) 3.2 Skeleton in Sponges; 3.3 Reproduction in Sponges. 3.4 Life cycle and pathogenicity of <i>Taenia</i> , <i>Ascaris</i> and <i>Fasciola hepatica</i> .	12
Unit - IV	Study of Earthworm: 4.1 Systematic position, Habits and habitat 4.2 External characters 4.3 Digestive system 4.4 Circulatory system 4.5 Nervous system and sense organs 4.6. Excretory system 4.7 Reproductive system 4.8 Economic importance (vermicompost).	14

References:

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

PAPER CODE: ZOO1102
PAPER - II: CELL BIOLOGY
Credits - 2C

Course Outcome	Teaching Pedagogy
Students completing the course of cell biology will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.	To understand the types of cells, teachers prefer blackboard method for diagrammatic presentation.
Students will be able to identify the eukaryotic and prokaryotic organisms and can differentiate plant and animal cells. They can describe structural organization, functioning and working mechanism of various components of the cell and understand their role in generation and utilization of energy in the cell.	Along with blackboard teaching, teachers show pictures and charts of cells of plants and animals for better understanding of their structure. Use of power point presentation for the study of structure and functions of various cell organelles.
Students will be able to understand the biomolecules and chemical complexity in the cell cytoplasm as well as in the cytoplasm of the cell. They can explain the arrangement of various biomolecules in the plasma membrane of the cell.	Use of ICT to show arrangement of biomolecules in the plasma membrane.
Students will be able to understand the mechanism of cell reproduction and the process of formation of haploid cells from the diploid one through meiosis.	Along with black board teaching, teachers use ICT to show animated clips of cell reproduction.
Students will also understand the mechanism of communication between the cell, the reason and necessity of the cellular death in the body and the cause and mechanism of conversion of normal cell into the cancerous one.	Along with black board teaching, teachers use ICT to show animated clips to show mechanism of communication between the cells and the cellular death.

	Title and Contents	No. of Lectures
Unit - I	Introduction to cell biology 1.1 Definition and scope of cell Biology 1.2 Introduction to cell theory.	02

Unit - II	Types of cells Organization of prokaryotic cell (<i>E.coli</i>) and eukaryotic cell (Plant and Animal).	02
Unit - III	Cell membrane 3.1 Organization of cell membrane: Fluid Mosaic Model 3.2 Chemical composition of cell membrane 3.3 Functions of cell membrane	05
Unit - IV	Cytoplasm 4.1 Chemical composition and properties of cytoplasm. 4.2 Cytoskeleton & ECM: Structure and Organization of Actin and Myosine filaments, Microtubules and Intermediate Filaments, Cell Movement.	04
Unit - V	Study of cell organelles with respect to structure and functions. 5.1 Endoplasmic reticulum 5.2 Golgi apparatus 5.3 Mitochondria 5.4 Lysosomes, peroxisomes and glyoxysomes 5.5 Ribosomes	12
Unit - VI	Nucleus 6.1 Shape, size, number and position 6.2 Ultra structure of nucleus 6.3 Functions of nucleus	03
Unit - VII	Cell division and its significance 7.1 Cell cycle 7.2 Mitosis 7.3 Meiosis	04
Unit - VIII	General Topics 8.1 Cell - cell signaling: apocrine, paracrine, endocrine 8.2 Apoptosis and its significance 8.3 Cancer cell: introduction, characteristics, proto-oncogene and oncogene.	04
References:		
<ol style="list-style-type: none"> 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. 		

PAPER CODE: ZOO1103

PAPER – III: ZOOLOGY PRACTICAL - I
[Credits - 2C No. of Practicals 10]

***D=Demonstration, E=Experiment, ABL= Activity Based Learning**

	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) 1. <i>Taeniasolium</i> 2. <i>Fasciola hepatica</i> 3. <i>Ascarislumbricoides</i> .
4	1. Temporary preparation of spicules from persevered sponge. (E) 2. Study of permanent slide of gemmule.
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)

PAPER CODE: ZOO1201
PAPER - I: Life and Diversity of Animals - II
Credits - 2C

Course Outcome	Teaching Pedagogy
Students completing the course of Life and Diversity of Animal-II will understand the characters and classification of chordate. They will be able to identify and classify the animal by observing their characters.	Use of museum specimens, charts and models along with field work. For better understanding of classification besides black board method and ICT, teacher shows slides and specimens.
Students will be able to find out the structural differences of animal and evolution of characters and systems. They will be able to divide animals in different categories.	Use of museum specimens for comparative study.
Students will be able to understand the evolution of different organs and systems form lower group of organism to higher group.	For teaching evolutionary aspects of animals, teachers use black board method and ICT in class room. In addition teachers show specimens of different animals to observe the characters.
Students will able to understand the structure and function of various organs and systems of frog as representative of chordates. Students will also understand the economic important of frog.	For teaching frog in class room, teachers use black board method and ICT. Teachers show models, permanent slides and preserved dissected specimens of frog.
Students will also understand the diversity based on fins and scales of different fishes.	Diagrammatic presentation and use of specimens of different species of fishes to observe the fins and scales.

	Title and Contents	No. of Lectures
Unit - I	General characters of Chordates and classification of chordates up to class.	04
Unit - II	General characters and classification of following subphyla upto class with one example. Hemichordata Urochordata and Cephalochordata	04
Unit - III	Salient features and classification with one example of the following: 3.1 Cyclostomata (up to order) 3.2 Pisces- (Chondrichthyes and Osteichthyes fishes) 3.3 Amphibia. (up to order)	04

Unit - IV	Study of Frog: 4.1 Systematic position, Habit and habitat 4.2 External characters and sexual dimorphism 4.3 Digestive system, food, feeding and physiology of digestion 4.4 Respiratory system. 4.5 Circulatory system (excluding lymphatic system) 4.6 Central Nervous system 4.7 Sense organs 4.8 Reproductive systems.	18
Unit - V	General topics: 5.1 Types of scales in fishes. 5.2 Parental care in Amphibians. 5.3 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 Jordan E. L., andVerma 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

PAPER CODE: ZOO1202
PAPER - II: PRINCIPLES OF GENETICS
Credits - 2C

Course Outcome	Teaching Pedagogy
Students will understand what is genetics and the concept of heredity and variation.	To understand the types of cells, teachers prefer blackboard method with illustration of various hereditary characters in human and other animals for diagrammatic presentation.
Students will be able to recognize the characters in an individual which are transmitted from the parents and also recognize variations in the genetic traits of different individuals in a population.	Teachers show pictures and charts of different organisms and use of power point presentation to show similarities and differences in the characters.
Students will test and verify their mastery of genetics by applying this knowledge in a variety of problem-solving situations.	Problems based on Mendelian concepts will be given to the students to apply the knowledge of genetics.
Students will be able to find out the probable breed or variety which can be produced from crossing of different existing varieties of plants or animals. Through the knowledge of cross breeding and self breeding they can develop a breed of desirable breed of plants or animals.	Teachers give examples of different existing breeds of plants and animals to find out expected breeds through the crosses applying various laws of inheritance.
Studying the mechanism of inheritance of blood groups and the fatal effect of incompatibility of blood groups; students will understand the importance of testing of blood groups before blood transfusion and before and after the marriage to avoid the complications which may develop in children due to mismatching of the blood groups.	Teachers explain the inheritance of different blood groups using black board method. In laboratory, teacher demonstrates the method of blood group detection.
Students will also understand the importance of karyotypic studies to avoid various genetic disorders which can be developed due to alteration in the structure and number of the chromosomes.	Teachers give demonstration about the preparation of karyotype by using photographs of chromosomal spread and also use the ICT to show characters of various syndromes.

	Title and Contents	No. of Lectures
Unit - I	<p>Introduction to genetics and Mendelian Principles:</p> <p>1.1 Definition and concept of Genetics</p> <p>1.2 Law of Dominance, Principle of Segregation , Principles of Independent Assortment</p> <p>1.3 Test cross and Back cross</p>	05
Unit - II	<p>Gene Interaction and lethality:</p> <p>2.1 Concept of gene interaction, Allelic gene interaction(co-dominance and incomplete dominance)</p> <p>Non allelic gene interaction (Complementary factor, Supplementary Factor, Inhibitory factor, Duplicate dominant factor)</p> <p>2.2 Lethal genes in Mice(<i>Mus musculus</i>)</p>	06
Unit - III	<p>Multiple Alleles:</p> <p>3.1 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.</p> <p>3.2 Concept of polygenic inheritance with reference to skin colour in human being</p>	04
Unit - IV	<p>Chromosomes:</p> <p>4.1 Morphological and molecular organization of chromosomes.</p> <p>4.2 Types of chromosomes: Autosomes, sex chromosomes and giant chromosomes (Lampbrush and polytene chromosomes).</p> <p>4.3 Chromosomal aberrations: structural changes and numerical changes: Autosomal Syndromes-Down's (Mongolism), Patau's, Edward's and Cri-du-chat.</p> <p>Sex chromosomal Syndromes -Klinefelter's and Turner's syndrome.</p>	11
Unit - V	<p>Study of Fruit fly (<i>Drosophila melanogaster</i>):</p> <p>5.1 Morphology and sexual dimorphism</p> <p>5.2 Life cycle</p> <p>5.3 Mutants: eye, wings and body colour (Two mutants of each type)</p> <p>5.4 Sex linkage.</p>	04
Unit - VI	<p>Human genetics:</p> <p>6.1 Study of human karyotype</p> <p>6.2 Inborn errors of metabolism (albinism, phenylketonuria (PKU) and alkaptonuria)</p> <p>6.3 Somatic cell hybridization.</p>	04
Unit - VII	<p>Sex linked inheritance in human being:</p> <p>7.1 Inheritance of Colour-blindness, haemophilia and hypertrichosis.</p> <p>7.2 Deleterious recessive sex linked gene - congenital hyperuricemia (Lesch-Nyhan syndrome) and Duchene- type Muscular Dystrophy (DMD).</p>	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.

PAPER CODE: ZOO1203
PAPER - III: Zoology Practical - II
[Credits - 2C: No. of Practicals 10]

***D=Demonstration , E=Experiment, ABL= Activity Based Learning**

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)