



**Deccan Education Society's**  
**Fergusson College (Autonomous),**  
**Pune**

Learning Outcomes-Based Curriculum  
for 3/4 years B. Sc. /B. Sc. (Honours) Programme  
as per guidelines of  
**NEP-2020**

for  
**F. Y. B. Sc. (Zoology)**  
With effect from Academic Year  
**2023-2024**

### Program Outcomes (POs) for B.Sc.

<b>PO1</b>	<p><b>Disciplinary Knowledge:</b> 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.</p>
<b>PO2</b>	<p><b>Critical Thinking and Problem solving:</b> Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.</p>
<b>PO3</b>	<p><b>Social competence:</b> Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibits thoughts and ideas effectively in writing and orally.</p>
<b>PO4</b>	<p><b>Research-related skills and Scientific temper:</b> 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.</p>
<b>PO5</b>	<p><b>Trans-disciplinary knowledge:</b> Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.</p>
<b>PO6</b>	<p><b>Personal and professional competence:</b> 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.</p>
<b>PO7</b>	<p><b>Effective Citizenship and Ethics:</b> 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.</p>
<b>PO8</b>	<p><b>Environment and Sustainability:</b> Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.</p>
<b>PO9</b>	<p><b>Self-directed and Life-long learning:</b> Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.</p>

<b>PSO No.</b>	<b>Program Specific Outcomes(PSOs)</b> <b>Upon completion of this programme the student will be able to</b>
<b>PSO1</b>	<p><b>Academic competence:</b></p> <p>(i) Develop deeper understanding of key concepts of Zoology at biochemical, molecular, cellular, physiological, histological and systematic level.</p> <p>(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.</p> <p>(iii) Assess environmental impact on applied and skill-based branches of Zoology</p>
<b>PSO2</b>	<p><b>Personal and Professional Competence:</b></p> <p>(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.</p> <p>(ii) Identify animals on the basis of comparative morphology and anatomy.</p>
<b>PSO3</b>	<p><b>Research Competence:</b></p> <p>(i) Integrate and explore biological data.</p> <p>(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.</p> <p>(iii) Identify and interpret research literature, formulate ideas, write reports and review articles related to the subject.</p>
<b>PSO4</b>	<p><b>Entrepreneurial and Social competence:</b></p> <p>(i) Empower the students by enhancing their self-sustainability capabilities through a thorough understanding of skill-based subjects and techniques by learning</p> <p>(ii) culturing techniques of economically important animals in applied and classical zoology.</p> <p>(iii) Develop social competence including listening, speaking, observational, effective interactive skills and presenting skills to meet global competencies.</p>

Fergusson College (Autonomous), Pune  
Proposed First Year Curriculum as per NEP 2020

**Department of Zoology**  
**Structure for Major / Minor**

Sem	Paper	Paper Code	Paper Title	Type	Credits
I	Major	ZOO-101	Systematics & Diversity of Life	Theory	4
		ZOO-100	Zoology Practical – I	Practical	2
	Minor	ZOO-111	Cell Biology	Theory	2
		ZOO-112	Zoology Practical – I	Practical	2
	OE-1	ZOO-120	Vector Diseases and Control	Theory	2
	OE-2	ZOO-121	Global Environmental Issues	Theory	2
	SEC-1	ZOO-140	Good Laboratory Practices	Skill	2
II	Major	ZOO-151	Genetics	Theory	4
		ZOO-150	Zoology Practical - II	Practical	2
	Minor	ZOO-161	Animal Systematics	Theory	2
		ZOO-162	Zoology Practical - II	Practical	2
	OE-3	ZOO-170	Human Physiology	Theory	2
	OE-4	ZOO-171	Biodiversity Conservation and Sustainable Development	Theory	2

\* OE – Open Elective, SEC- Skill Enhancement Course

**Teaching and Evaluation (Only for FORMAL education courses)**

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	3 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

**Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)**

<b>F.Y.B.Sc. Semester I</b>		
<b>ZOO-101</b>	<b>Systematics and Diversity of Life (Major- Theory)</b>	<b>Credits: 4 Hours: 60</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Define terms related to multicellularity, animal systematics and outline the various systems of classification.	1
CO2	Explain the structure and diversity in Protists, origin of Metazoans, Cnidarians Bilateria, Acoelomates	2
CO3	Illustrate the characteristics of Ecdysozoa : Pseudo coelomates. Outline the basic organization and adaptive radiations in roundworms.	3
CO4	Explain the characteristics of the Coelomates, Arthropods and Molluscs.	4
CO5	Assess the characteristics of primitive chordates and evaluate advent of vertebrates.	5
CO6	Create a comparative chart and write the evolutionary characters of different Chordate groups.	6

<b>Unit</b>	<b>Contents</b>	<b>No. of hours</b>
<b>I</b>	<b>Origin of Life on Earth, Products of evolutionary process:</b> Multicellularity: from simple collections of poorly differentiated cells to complex body plans. Biological diversity. Animal Systematics and taxonomy. Species concept, clades. Nomenclature and utility of scientific names. Classification: morphological and evolutionary (molecular).	<b>15</b>
<b>II</b>	<b>Diversity in Protists and acoelomate Metazoa:</b> Structure and diversity in Protists. Origin of Metazoans: Diploblastic and triploblastic organization; symmetries; body cavities; protostomes and deuterostomes. Special features and structural diversity in sponges. Cnidarians: Special features; polymorphism and division of labour. The Bilateria: Basic characteristics. The acoelomates: Basic organization and adaptive radiations in flatworms.	<b>15</b>

<b>III</b>	<p><b>Diversity in pseudocoelomate and coelomate:</b></p> <p>The Ecdysozoa: characteristics of the representative taxa. Pseudo coelomates; Basic organization and adaptive radiations in roundworms.</p> <p>The coelomates: - Basic organization and diversity in Annelids. Basic organization of Arthropods and its diversity. Basic organization and diversity in Molluscs. Basic organization of Echinoderms; their affinity to Chordates.</p>	<b>15</b>
<b>IV</b>	<p><b>Diversity in Protochordates and Chordates:</b></p> <p>Chordates – Primitive Chordates and their affinities. Hemichordates, Urochordates and Cephalochordates. Advent of vertebrates: Cyclostomes. Basic organization and diversity of fishes. Amphibians diversity and adaptability to dual mode of life. Amniotes: structure of amniotic egg. Birds: Adaptation from terrestrial to aerial mode of life.</p> <p>Origin of Mammals- Special features of Monotremes and Marsupials. Characteristics of other mammalian groups with special reference to primates.</p>	<b>15</b>

### References

1. Barnes, R. S. K.; Calow, P.; Olive, P. J. W.; Golding, D. W.; Spicer, J. I. (2002) The Invertebrates: a Synthesis, Blackwell Publishing.
2. Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
3. Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
4. Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw- Hill.
5. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
6. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
7. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

<b>F.Y.B.Sc. Semester I</b>		
<b>ZOO-100</b>	<b>Zoology Practical - I (Major-Practical)</b>	<b>Credits: 2 Hours: 60</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Recall the classification system of Invertebrates and chordates animals. Identify the animals belonging to different phylum of animals.	1
CO2	Classify the invertebrates and vertebrate's animals belonging to various classes. Explain the morphological features of animal and differentiate the fauna based on morphological features.	2
CO3	Interpret the data of field visit. Organize the animals as per their hierarchy of classification.	3
CO4	Classify and compare the chordates and non-chordates based on morphological characters of Animals.	4
CO5	Discriminate between animals belonging to Chordates and non-Chordates.	5
CO6	Construct the classification schemes of animals based on morphological features.	6

Any 10 experiments: 8 compulsory + 1 Activity (Equivalent to Two Practical's)

<b>Expt. No.</b>	<b>Title of the Experiment</b>
1.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Protista, and Porifera. (one Specimen from each class.)
2.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Cnidaria and Helminths (one specimen from each class of Cnidaria and Platyhelminthes.)
3.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Annelida and Arthropoda ( one specimen from each class of Annelida and one Specimen from each subphylum of Arthropoda.)
4.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Mollusca and Echinodermata (one specimen from each class of from Mollusca and Echinodermata.)
5.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from

	Protochordata, Cyclostomata and Pisces. (one specimen from each class of Hemichordata, Urochordata, Cephalochordata and Cyclostomata, One specimen from Chondrichthyes and Ostichthyes).
6.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Amphibia and Reptilia. (one specimens from each order of class Amphibia and Reptilia).
7.	Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features from Aves and Mammals. (One specimen from Archaeornithes, and Neornithes of class Aves, one Specimen from Prototheria, Metatheria and Eutheria of class Mammals).
8.	Temporary preparation of slide of Spicules and study of gemmules from Sponges.
9.	Study and temporary preparation of slide of different types scales from Fishes.
10.	Study of animals in nature during a survey of a National Park or Forest area.
11.	A project work on any five wild animals' species- generic identification, description and illustration with a note on their locality.
12.	Comparison of two chordate species belonging to same genus (Interspecific difference). Comparison and weighting of characters of two chordates belonging to same family but dissimilar genera.



<b>F.Y.B.Sc. Semester I</b>		
<b>ZOO-111</b>	<b>Cell Biology (Minor-Theory)</b>	<b>Number of Credits: 02 Hours: 30</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Describe the concept of cell theory. Recall types of cells and label its components.	1
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.	2
CO3	Illustrate the process of mitosis and meiosis.	3
CO4	Identify and draw diagrams of cell organelles and analyze their functions.	4
CO5	Review the process of cell cycle.	5
CO6	Write about the cell theory with cellular activities which leads to repairing and regeneration of the cells and the production of energy.	6

<b>Unit. No.</b>	<b>Title of Unit and Contents</b>	<b>No. of Lectures</b>
I	<b>Introduction to cell biology</b> Definition and scope of cell Biology, Introduction to cell theory.	02
II	<b>Types of cells</b> Organization of prokaryotic cell ( <i>E. coli</i> ) and eukaryotic cell (Plant and Animal).	02
III	<b>Cell membrane</b> Organization of cell membrane: Fluid Mosaic Model, Chemical composition of cell membrane, Functions of cell membrane	05
IV	<b>Cytoplasm</b> Chemical composition and properties of cytoplasm, Cytoskeleton & ECM: Structure and Organization of Actin and Myosin filaments, Microtubules and Intermediate Filaments, Cell Movement.	02
V	<b>Study of cell organelles with respect to structure and functions.</b> Endoplasmic reticulum, Golgi apparatus, Mitochondria, Lysosomes, peroxisomes and glyoxysomes, Ribosomes.	12
VI	<b>Nucleus</b> Shape, size, number and position, Ultra structure of nucleus, Functions of nucleus.	03
VII	<b>Cell division and its significance</b> Cell cycle, Mitosis, Meiosis.	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

<b>F.Y.B.Sc. Semester I</b>		
<b>ZOO-112</b>	<b>Zoology Practical - I (Minor- Practical)</b>	<b>Number of Credits: 02 Hours : 60</b>
<b>Course Outcomes (COs) On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Describe fundamental concepts of cell division and standard operating procedures of compound microscope.	1
CO2	Differentiate functions of Cell Organelles.	2
CO3	Demonstrate the procedure of detection of mitochondria, preparation of slide for mitosis and identify various stages of mitosis.	3
CO4	Differentiate the features of prokaryotic and eukaryotic cells and compare plant cell and animal cell.	4
CO5	Review the Process of Cyclosis.	5
CO6	Compile the data of different types of Microscopes.	6

<b>Sr. No.</b>	<b>Title of Experiment/ Practical</b>
1	Use of compound microscope.
2	Study of Prokaryotic and Eukaryotic cell with the help of permanent slide/ picture/model/chart.
3	Study of Prokaryotic cells by using Gram's staining method.
4	Study of Cell organelles (Mitochondria, Endoplasmic reticulum, Golgi complex) with the help of electron microscopic photograph/ picture/ model/ chart.
5	Detection of mitochondria from onion peel by Janus Green staining.
6	Study of different mitotic stages in onion root tips.
7	Effect of colchicine on mitosis.
8	Study of unicellular organisms from freshwater body.
9	Study of cyclosis in paramecium.
10	Effect of phototaxis on Paramecium/Euglena.
11	Study of trichocyst in paramecium.
12	Write a report on principle and working of different types of microscopes in the Department of Zoology.

F.Y.B.Sc. Semester I		
<b>ZOO-120</b>	<b>Vector, Diseases and Control (OE-1)</b>	<b>Credits: 2 Hours: 30</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Define and describe term host, vector, their types, morphological peculiarities, and vector bionomics.	1
CO2	Illustrate salient features of the different vectors, causes of disease outbreak and the vector management strategy.	2
CO3	Demonstrate the role of non-blood sucking and blood sucking flies in transmission of diseases and their management.	3
CO4	Explain the control of vector flies by screening and different methods.	4
CO5	Appraise methods of biological control by natural parasites and predators, chemical control, sterile insect technique.	5
CO6	Write emerging concepts and approaches to vector management through legislation and regulation of vectors and diseases.	6

Unit	Conte nts	No. of hours
<b>I</b>	<b>Vector and vector bionomics</b> Brief introduction, types and morphological peculiarities of vectors such as mosquitoes, flies, fleas, lice, bugs, ticks and mites. Host-vector relationship. Primary and secondary vector concept. Vectorial capacity. Vector bionomics-larval habitats and host biting preferences, human and animal biting indices.	<b>8</b>
<b>II</b>	<b>Disease vectors and the causes of disease outbreaks</b> Salient features of the vectors belonging to Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina (families Ixodidae and Argasidae) etc. Role of non-blood sucking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fevers. Examples of few diseases.	<b>10</b>
<b>III</b>	<b>Vector management strategies</b> Control of vector flies by screening, fly traps, electrocution, poison baits and outdoor residual sprays; biological control by natural parasites and predators. Chemical control. Biological control of mosquitoes by the use of viruses, bacteria, fungi, parasites, nematodes and larvivorous fishes. Sterile insect technique,	<b>10</b>

<b>IV</b>	<b>Emerging concepts and approaches to vector management</b> Legislation and regulation of vectors and diseases.	<b>2</b>
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**References:**

1. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.
2. Chapman, R.F. (1998). The Insects: Structure and Function.IV Edition, Cambridge University Press, UK.
3. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector borne Disease.Wiley-Blackwell.
4. Belding, D.L. (1942). Textbook of Clinical Parasitology. Appleton-Century Co., Inc., New York.
5. Roy, D.N. and Brown, A.W.A. (2004). Entomology. Biotech Books, Delhi

<b>F.Y.B.Sc. Semester I</b>		
<b>ZOO-121</b>	<b>Global Environmental Issues (OE-2)</b>	<b>Credits: 2 Hours: 30</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Define distinct types of pollution, Recall the concept Eutrophication, their impact and biotechnological approaches for management.	1
CO2	Explain the fundamental issues of environment and the effect of UV rays, ozone depletion, greenhouse effect.	2
CO3	Illustrate the aerobic and anaerobic process of decomposition of sludge.	3
CO4	Analyze different sources of environmental problems and methods of measurement of pollution.	4
CO5	Assess the data of environmental economics.	5
CO6	Hypothesize the environmental issue related to pollution.	6

<b>Unit</b>	<b>Contents</b>	<b>No. of hours</b>
<b>I</b>	<b>Environment and Environmental Problems</b> Basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, Fisheries depletion, Eutrophication, their impact and biotechnological approaches for management.	<b>8</b>
<b>II</b>	<b>Environmental Pollution</b> Environmental pollution - types of pollution, Air, water and land pollution. sources of pollution, measurement of pollution, fate of pollutants in the environment, Ocean acidification, Bioconcentration, bio/magnification.	<b>10</b>

<b>III</b>	<b>Environmental Economics</b> Environmental Economics: Basic concept; methods of evaluation; Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit ratio and cost effectiveness analysis.	<b>10</b>
<b>IV</b>	<b>Use of Microbes in Waste Water Treatment</b> Aerobic decomposition process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic decomposition process - anaerobic filters, up- flow anaerobic sludge blanket reactors. Treatment schemes for sewage from dairy, distillery, tannery, sugar and pharma industries.	<b>2</b>

### References

1. Frances, H. (2012). Global Environmental Issues (2<sup>nd</sup> edition) Willey-Blackwell
2. Mahesh, R. (2007) Environmental Issues in India: A Reader. Pearson-Longman.

F.Y.B.Sc. Semester I		
<b>ZOO-140</b>	<b>Good Laboratory Practices (SEC-1)</b>	<b>Credits: 2 Hours: 30</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Describe the biohazard agents, risk groups and Biosafety, safety measures in laboratories	1
CO2	Outline the methods of preparation and labeling of reagents and chemicals by considering basis like molarity	2
CO3	Illustrate weighing and staining procedure	3
CO4	Classify reactive dyes and monochrome	4
CO5	Review whole mount and tissue preparation methods	5
CO6	Integrate key relevant problems and association in zoology research	6

<b>Unit</b>	<b>Contents</b>	<b>No. of hours</b>
<b>I</b>	Laboratory Safety, Biohazardous Agents, Risk Groups and Biosafety Levels, Laboratory Acquired Infections, Safety Measures in Laboratory	<b>5</b>
<b>II</b>	Understanding the details on the label of reagent bottles. Preparation of solutions. Molarity and normality of common acids and bases. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes and Maintenance of equipment's.	<b>10</b>

<b>III</b>	Weighing and staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluoro-chromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed tissues.	<b>5</b>
<b>IV</b>	Whole mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin; Preparation of thin and ultrathin sections.	<b>10</b>
<b>V</b>	History; Key relevant problems associated in Zoology research areas, their solution and basic understanding of animal models used in Zoology Research.	<b>5</b>

### References

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; (2nd edition).
2. Garner, W.Y., Barge, M.S. and Ussary, P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.
3. Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
4. Cytological techniques: The Principles Underlying Routine Methods, 1963, Baker J. R., Methuen & Co., London.
5. Davenport H. A.: Histological and Histochemical techniques.
6. Handbook of basic Microtechnique, 1958, 2nd ed., Gray P., McGraw - Hill, USA
7. Staining methods (Histological and Histochemical), 1960, Mc Manus J. F. A. and Mowry R. W., Paul B. Hoeber, Inc.; Harper & Brothers, NY.
8. Elementary Microtechnique, 1973, 4th Edn., Peacock H. A., Edward Arnold Publ. Ltd., UK.
9. Good Laboratory Practice- Handbook, UNDP/World Bank?WHO

### Webliography

1. [A Guide to Good Laboratory Practice \(GLP\) | Safety Culture](#)
2. [Home page - OECD](#)
3. [Good Laboratory Practices \(GLP\) - SOP & Guideline - Pharma Beginners \(pharmabeginners.com\)](#)

**F.Y.B.Sc. Semester II**

ZOO-151	<b>Genetics (Major-Theory)</b>	<b>Credits: 4 Hours: 60</b>
<b>Course Outcomes (COs)</b> On completion of the course, the students will be able to:		<b>Bloom's cognitive level</b>
CO1	Define and describe different terminology and concepts in genetics.	1
CO2	Articulate the causes and effects of alterations in chromosome number and structure.	2
CO3	Illustrate the principles of Mendelian inheritance.	3
CO4	Relate the conventional and molecular methods for gene manipulation in other biological systems.	4
CO5	Appraise and justify principles of Mendelian and non Mendelian inheritance, methods of sex determination.	5
CO6	Integrate the knowledge to find new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, etc.	6

Unit	Contents	No. of hours
<b>I</b>	<b>Concept Genes and Genomics</b>  Genetics: scope and importance. Elements of heredity and variation: Classical and Modern concept of Gene (Cistron, muton, recon), Alleles etc. Mendel's laws of inheritance, Chromosomal basis of inheritance and its applications. Exceptions to Mendelian Inheritance: Incomplete dominance, Codominance, Multiple allelism, Lethal alleles, Pleiotropy, Epistasis - Recessive, Double recessive and double dominant. Genomic imprinting, Penetrance and expressivity, Polygenic inheritance. Mendelian traits in man. Applications of Genomics.	<b>15</b>
<b>II</b>	<b>Extra nuclear inheritance and sex determination in organisms</b> Organelle inheritance (Mitochondrial) Extra-nuclear inheritance, Maternal Inheritance, Sex Chromosomes and sex-linkage: XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types, Gene dosage Compensation, meiotic consequences in structural heterozygotes. Autosomal dominant and autosomal recessive, X-linked dominant, and X-linked recessive. Haplodiploidy, intersex, gynandromorphs. Hormonal influence on sex determination-Free martin and sex reversal. Role of environmental factors- Bonellia and Crocodile.	<b>15</b>



<b>III</b>	<b>Human Genetics/ Introduction to inborn errors</b> Human Genetics: Morphological and molecular organization of chromosome, banding and nomenclature of chromosome subdivisions. Pedigree analysis. Karyotype, Structural and numerical alterations of chromosomes, Genetic disorders: chromosomal aneuploidy (Down, Turner and Klinefelter syndromes), chromosome translocation (Chronic Myeloid Leukemia) and deletion (“cry of cat” syndrome), gene mutation (sickle cell anemia). Inborn errors of metabolisms- PKU, AKU. Albinisms.	<b>15</b>
<b>IV</b>	<b>Application of Genetics</b> Utility of the model organisms: Escherichia coli, Arabidopsis thaliana, Caenorhabditis elegans, Drosophila melanogaster & Mus musculus. Genetic counselling, Gene therapy. Concept of genetic engineering, principle and applications of PCR, DNA fingerprinting and its applications. Animal cloning.	<b>15</b>

### References

1. Gardner, E.J. et al. (2006) Principles of Genetics (John Wiley).
2. Russell, P.J. (2010) Genetics (Benjamin Cummings).
3. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. (VIII edition) Wiley India.
4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. (V edition) John Wiley and Sons Inc.
5. Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
6. Carroll S.B.; Doebley J.; Griffiths, A.J.F. and Wessler, S.R. (2018) An Introduction to Genetic Analysis. W. H. Freeman and Co. Ltd.

<b>F.Y.B.Sc. Semester II</b>		
<b>ZOO-150</b>	<b>Zoology Practical - II (Major- Practical)</b>	<b>Credits: 2 Hours: 60</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Recall the fundamental concepts of genetics, sex linked inheritance, multiple alleles and mutation.	1
CO2	Discuss, techniques of handling Drosophila flies and identify different mutants.	2
CO3	Demonstrate Drosophila culture technique, applications DNA fingerprinting and thermal cycler. Apply principles of inheritance to solve problems based on monohybrid, dihybrid crosses and genic interaction.	3
CO4	Detect A, B, AB, O and Rh blood groups.	4
CO5	Evaluate different genetic traits in human being and analyze the human karyotype	5
CO6	Compile the data of different syndromes in human beings and prepare a report	6

Any 12 experiments: 10 compulsory + 1 Activity (Equivalent to Two Practical)

<b>Expt. No.</b>	<b>Title of the Experiment</b>
1.	To solve problems based on Monohybrid and dihybrid crosses. (Two problems each).
2.	To solve problems based on deviation from Mendelian inheritance.
3.	Frequency of the following genetic traits in human: widow's peak, attached ear lobe, dimple in chin, hypertrichosis, colour blindness, PTC tasting.
4.	Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.
5.	Familiarization with techniques of handling Drosophila, identifying males and females.
6.	Demonstration of setting up Drosophila culture and observing wild type and mutant (white eye, wing less, curly wings) flies.
7.	Demonstration of multiple allelism and determination of blood groups (ABO AND Rh).
8.	Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).

9.	Application of DNA fingerprinting (photograph of electrophoretic pattern to be given for interpretation by the students).
10.	Study of principle and applications of thermal cyclers.
11.	Study of genetic disorders from human population (any two).
12.	Study of techniques of animal cloning.

**F.Y.B.Sc. Semester II**

<b>ZOO-161</b>	<b>Animal Systematics (Minor-Theory)</b>	<b>Credits: 2 Hours: 30</b>
<b>Course Outcomes (COs)</b>		<b>Bloom's cognitive lev</b>
<b>On completion of the course, the students will be able to:</b>		
CO1	Define the term related to Animal systematics and general life processes.	1
CO2	Outline the general characters of Phylum or Class of animals. Illustrate general life processes in animals.	2
CO3	Classify the Invertebrates and Vertebrates.	3
CO4	Classify by giving example of each phylum or class and explain bioluminescence, Coral formation, regeneration in animals, pearl formation in Molluscs, mimicry in butterflies, migration in fishes and birds, echolocation in bats and Cetacean,/ Parental care in Amphibians.	4
CO5	Compare the general characters of two phyla or classes of animals.	5
CO6	Arrange the classification of given example by considering salient features of its Class or Phylum. Write about general life process in Invertebrates and Vertebrates.	6

<b>Unit</b>	<b>Contents</b>	<b>No. of hours</b>
<b>I</b>	<b>Outline of classification with salient features of the following phyla of Non - chordates:</b> (with one example each). Phylum Protozoa, Porifera, Coelenterata (Cnidaria), Platyhelminthes, Aschelminthes Annelida, Arthropoda, Mollusca and Echinodermata.	<b>10</b>
<b>II</b>	<b>General topics:</b> 1) Bioluminescence in Animals: Noctiluca, Glow worm, Firefly, (Mechanism and use for the animal) 2) Mechanism of Coral formation and types of coral reefs. 3) Regeneration in Animals – Earthworm (Annelida) and Lizard (Reptile) 4) Mechanism of Pearl formation in Mollusca. 5) Mimicry in Butterflies and its significance.	<b>5</b>
<b>III</b>	<b>Outline of classification with salient features of phylum Chordata up to class</b> (with one example each): Subphylum- Hemichordata, Urochordata and Cephalochordata. Superclass: Pisces, Class: Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves and Mammals.	<b>10</b>
<b>IV</b>	<b>General Topics</b> 1) Migration in fishes (Anadromous and Catadromous). 2) Parental care in Amphibians. 3) Migration in Birds. 4) Echolocation in Bats and Cetaceans – Dolphins and Whales.	<b>5</b>

## 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 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 Coelentrates 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.
12. Biology of Animals by Ganguly, B. B., Sinha, A. K., Adhikari, S., New Central Book Agency, Kolkata
13. Introduction to Amphibia by Bhamrah, M. S., Juneja, K., Anmol Publication, Delhi
14. Life of Vertebrates by Young, J. Z., III Edition, Clarendon Press, London.
15. General Zoology by Goodnight and others IBH Publishing Co.
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17. General Zoology by Goodnight and others IBH Publishing Co.

4		
ZOO162	Zoology Practical - II (Minor - Practical)	Number of Credits: 02 Hours : 60
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Recall outline classification of Non chordates and chordates.	1
CO2	Discuss, identify and classify different species of animals from Hemichordata, Cephalochordata, Urochordata, Cyclostomata, cartilaginous fishes and Bony Fishes	2
CO3	Illustrate different morphological features of various specimens of invertebrates.	3
CO4	Discriminate characters of chordates and non-chordate animals. Demonstrate the slide preparation of spicules in sponges and scales in fishes.	4
CO5	Appraise and classify the specimens from Zoology museum.	5
CO6	Compile the data obtained from observations of animals in the field and organize it as per animal systematics.	6

Sr. No.	Title of Experiment/ Practical
1	<b>To study the classification with reasons of the following</b> Phylum Protozoa- <i>Paramecium</i> , <i>Amoeba</i> Phylum Porifera- <i>Sycon</i> , <i>Hyalonema</i> and Phylum Coelenterata (Cnidaria) - <i>Hydra</i> , <i>Phylasia</i>
2	<b>To study the classification with reasons of the following</b> Phylum Platyhelminthes- <i>Planaria</i> , <i>Taenia</i> Phylum Aschelminthes- <i>Ascaris</i> , <i>Wuchereria</i> . Phylum Annelida – <i>Neries</i> , <i>Hirudina</i> . Phylum Mollusca – <i>Mytilus</i> , <i>Octopus</i>
3	<b>To study the classification with reasons of the following</b> Phylum Arthropoda- <i>Palaemon</i> , <i>Mantis</i> Phylum Echinodermata- <i>Asteria</i> , <i>Holothuroidea</i>
4	<b>To study the classification with reasons of the following</b> Sub phylum - Hemichordata- <i>Balanoglossus</i> Sub phylum - Urochordata- <i>Doliolum</i> and <i>Herdmania</i> Sub phylum – Cephalochordata <i>Amphioxus</i>
5	<b>To study the classification with reasons of the following</b> 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>
6	<b>To study the classification with reasons of the following</b>

	Class- Amphibia: <i>Ichthyophis, Bufo</i> Class- Reptilia: <i>Hemidactylus, Chameleon</i>
7	<b>To study the classification with reasons of the following</b> Class- Aves: <i>Dendrocopus</i> (Woodpecker), <i>Owl</i> Class- Mammals: <i>Ornithorhyncus, Pteropus</i> (Flying fox)
8	Temporary preparation of spicules from persevered sponge. Study of permanent slide of gemmule.
9	Temporary preparation of placoid / cycloid / ctenoid scales from preserved fishes.
10	Study of breeding and parental care in Amphibians – Rhacophorous, midwife toad, Caecilians.
11	Study of accessory respiratory organs in fishes.
12	Identification and differentiation of venomous and non- venomous snakes.

Any 12 experiments: 10 compulsory + 1 Activity (Equivalent to Two Practical)

**F.Y.B.Sc. Semester II**

<b>F.Y.B.Sc. Semester II</b>		
<b>ZOO-170</b>	<b>Human Physiology (OE-3)</b>	<b>Credits: 2 Hours: 30</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Tell and explain different terms and processes in physiology.	1
CO2	Articulate physiological mechanism of different systems in human body.	2
CO3	Illustrate processes of digestion, respiration, circulation, reproduction and endocrine activities.	3
CO4	Explain and develop understanding of structure and functions of kidney and heart.	4,6

<b>Unit</b>	<b>Contents</b>	<b>No. of Hours</b>
<b>I</b>	<b>How are processes of digestion accomplished in man?</b> Digestive glands: Structure and function. Digestion and absorption of nutrients: carbohydrates, fats and proteins. Neural and hormonal control of digestion.	<b>7</b>
<b>II</b>	<b>An overview of muscular function in man</b> Structure of smooth, skeletal and cardiac muscles. Neuromuscular junction. Mechanism of muscle contraction. Respiration: Ventilation, External and internal respiration. Transport of carbon dioxide and oxygen in blood and tissues. Factors affecting gaseous transport.	<b>6</b>
<b>III</b>	<b>Cardiovascular functions in man</b> Structure of heart. Coordination of heartbeat; control of heart beat (neural and hormonal) Blood cells and blood vessels. Cardiac cycle. ECG. Lymph and lymph vessels.	<b>7</b>
<b>IV</b>	<b>Endocrine and reproductive physiology</b> Structure and function of endocrine glands viz., pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries and testes. Fertilization and implantation. Menstrual cycle. Pregnancy and Parturition.	<b>10</b>

**References**

1. Tortora, G.J. and Derrickson, B.H. (2009) Principles of Anatomy and Physiology (12th edition) John Wiley and Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology (9th edition) McGraw Hill.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology (12th edition) Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Marieb, E. (1998) Human Anatomy and Physiology (4th edition) Addison-Wesley.
5. Kesar, S. and Vashisht, N. (2007) Experimental Physiology, Heritage Publishers



<b>F.Y.B.Sc. Semester II</b>		
<b>ZOO-171</b>	<b>Biodiversity Conservation and Sustainable Development (OE-4)</b>	<b>Credits: 2 Hours: 30</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		<b>Bloom's cognitive level</b>
CO1	Describe Anthropogenic impact on environment, and threats to biodiversity and extinction of species.	1
CO2	Discuss the judicious utilisation of natural resources	2
CO3	Demonstrate the concept of green technology and the eco-friendly practices and other prospects of environment protection	3
CO4	Analyse and practice appropriate legal/regulatory and ethical issues in the context of the work environment.	4
CO5	Assess the importance of bio diversity and the consequences of bio diversity loss	5
CO6	Design research projects to collect information to assess the effectiveness of current practices, and interpret the results of a statistical analysis of data, and use this to make informed decisions.	6

<b>Unit</b>	<b>Contents</b>	<b>No. of hours</b>
<b>I</b>	<b>Anthropogenic impact on environment</b> Man as an animal species in the ecosystem. Population explosion. carrying capacity, exploitation of resources due to urbanization, industrialization and agricultural practices. Generation of agricultural, municipal, industrial waste; Pollution of air, water, soil and noise; radioactive pollution. Eutrophication. Deforestation, Afforestation, Reforestation; Threats to biodiversity, Extinction of species.	<b>7</b>
<b>II</b>	<b>Depletion and contamination of resources</b> Natural resources: Land resources. Air and water resources. Bioresources. Conventional Fuel, wood, fossil fuels. Non-conventional or alternate sources of energy: sun, wind, bio-energy, geothermal, ocean, nuclear etc. Green house effect and global warming; climate change; Shrinking of glaciers. Threats to sustainable development.	<b>6</b>
<b>III</b>	<b>Biodiversity and resource conservation programmes</b> Management of wastes and disposal. Concepts of three Rs: reduce, reuse and recycle. Methods of prevention and control of Eutrophication. Bioremediation. Biodiversity conservation– In-situ e.g., Sanctuaries, National Parks, Biosphere Reserves, World Heritage Sites; Ex-situ e.g., botanical gardens, gene banks, cryopreservation etc. Contour farming, reforestation; Rainwater harvesting, groundwater water recharge. Green technologies, Eco- cities, Social and Joint forestry.	<b>7</b>

<b>IV</b>	<p><b>Sustainable development and green technology</b></p> <p>Sustainable Development; Brundlandt Report. Biosafety of GMOs and LMOs. Environmental movements. Public awareness of Environment problems. Role of Government, NGO's, Ecological footprint, International treaties and conventions. organizations, International efforts (Vienna Convention, Montreal Protocol, UNFCCC, Kyoto Protocol, Copenhagen Summit, etc.; IPCC; Environmental laws and acts. National Environmental Policy.NBPGR, BSI, ZSI, WWF, IUCN, Convention on Biological diversity; Ramsar Convention, other conservation efforts.</p>	<b>10</b>
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### **References**

1. Joseph, B. (2008) Environmental studies, Tata McGraw Hill.
2. Miller, G.T. (2002). Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc.
3. Chapman, J.L. and Reiss, M.J. (1999). Ecology: Principles and applications (2nd edition) Cambridge University Press.
4. Ghosh, S.K. and Singh, R. (2003). Social forestry and Forest Management. Global Vision Pub.
5. Wilson, E.O. (1986) Biodiversity, Academic press Washington
6. Wagher, R.H. (1974) Environment and Man. (Second Edition), Norton, New York.