Savitribai Phule Pune University, Pune

(Formerly, University of Pune)

4 Year Bachelor Degree Program in Zoology

(Faculty of Science & Technology)

To be implemented from Academic Year 2024 - 2025

Revised Syllabi for B. Sc. Zoology

As per National Education Policy (2020) for

F. Y. B. Sc. Zoology (Semester I & II)

(for Colleges Affiliated to Savitribai Phule Pune University, Pune)

Framed by

BOARD OF STUDIES IN ZOOLOGY

(Prof. Dr. R. D. Chaudhari)
Chairman - BOS
Zoology

Savitribai Phule Pune University,

Ganeshkhind, Pune – 411 007

❖ Aims and Objectives :

- Focus is on building concepts in biological sciences and enabling them to apply their experimental knowledge in various sectors of life sciences specifically in animal biology.
- Specifically, this programme aims at enhancing the professional competencies and skills.
- Analyze complex interactions among various animals of different phyla, their distribution and their relationship with the environment.
- Helps to understand the physiological, biochemical, molecular and genetic principles of animals and their surroundings.
- Empower learners by enabling them with communication, professional and life skills.
- This course provides an advanced knowledge of modern biology and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

❖ Program outcomes (POs) :

The curriculum in designed after a long thinking and interacting process with various components of the stakeholders. After successful completion of B. Sc. Zoology Major program students will be able to gain the basic, applied and research based knowledge pertaining to the various branches of Animal sciences.

1. Knowledge and skills on the topic :

i. In-depth knowledge of the major concepts, theoretical principles and experimental skills of zoology and its various fields, including biodiversity, anatomy, physiology, biochemistry, bio-nanotechnology, ecology, evolutionary biology, cell biology, molecular biology, immunology, genetics, as well as some other areas of applied research such as wildlife conservation and management, beekeeping, sericulture, vermiculture, neuroscience, aquatic biology, fisheries science, animal breeding, bioinformatics and research methodology, etc.

ii. Interdisciplinary knowledge of life sciences, environmental sciences, and related bio-chemical sciences.

iii. Learn about the various techniques, tools, and computer software used to analyze the forms and functions of animals.

2. Skillful communication : Ability to communicate complex zoological information effectively and efficiently.

3. **Critical thinking and problem-solving skills :** The ability to rationally analyze and solve animal science issues without relying on hypotheses and guesswork.
4. **Logical thinking and reasoning :** Ability to search for solutions and solve them logically by experimenting and processing the data manually or by using softwares.
5. **Team spirit and leadership qualities :** Ability to identify and mobilize the resources required for the project and management of the project responsibly while adhering to ethical scientific concern and bio-safety protocols.
6. **Digital efficiency :** Ability to use computers and other tools for biological simulations, calculations, appropriate bio-statistical software, and research tools to locate, retrieve, and evaluate zoology-related data.
7. **Ethical awareness and reasoning :** Avoid unethical behaviour such as data falsification, forgery or deception, plagiarism and value environmental and sustainability issues.
8. **Lifelong learning :** Capable of independent, self-directed learning with the aim of personal and social development.
9. **Entrepreneurship qualities :** Develop entrepreneurship qualities as this course contains almost all branches of applied zoology. One can establish a start up project by learning various courses.
10. **Advanced education :** Students will be able to develop their mind with some advanced and superior knowledge, research outcomes and also the new as well as easy system of education. This will make them more reliable and capable in the world to lead the nation.

❖ Program Specific Outcomes (PSOs) :

PSO 1 : After completion of this course students will be able to contribute as policy makers in biodiversity conservation, animal preservation and environment protection.

PSO 2 : Equip with the knowledge of animal classification and diversity, ecology and economic importance of animals.

PSO 3 : Acquire the advanced concepts in insect rearing and various animal breedings for the food security of human beings.

PSO 4 : Inculcate the traditional knowledge of using various animal based products in human healthcare system.

PSO 5 : Adapt scientific research techniques in various applied branches of Zoology for sustainable development.

PSO 6 : Perform procedures as per laboratory standards in the areas of Taxonomy,

Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Toxicology, Entomology, Sericulture, Biochemistry, Fish biology, Animal breeding and Clinical Pathology.

PSO 7 : Zoology course also provide a knowledge of applied subjects to develop various skills to make a career and become an entrepreneur in the field of aquatic biology, sericulture, apiculture, vermiculture, prawn culture, dairy management, animal breeding and management, wildlife conservation and management, wildlife photography etc.

PSO 8 : Analyze the relationships among animals, plants, and microbes.

PSO 9 : Understand and analyze the ecological and evolutionary significance of different taxa of animals.

PSO 10 : Analyze the mechanisms involved in life processes up to the molecular level.

PSO 11 : Gains knowledge about research methodologies, effective communication and skills of problem solving methods.

PSO 12 : Contributes the knowledge for Nation building.

❖ Course Title :

- B. Sc. Zoology Major (03 years) / B. Sc. Honours in Zoology (04 years) / B. Sc. Honours in Zoology with Research (04 years).
- Revised syllabus as per the National Education Policy (NEP), 2020 for the Colleges Affiliated to Savitribai Phule Pune University, Pune.

❖ Faculty : Science and Technology

❖ Preamble :

Zoology is a significant branch of study in the Basic Sciences, which covers every facet of animal biology. Animals and organisms almost occupy every habitat available to them, and they are indivisible part of all ecosystems, food chains and food webs.

The goal of the National Education Policy 2020 (NEP 2020) is to prepare students for lifelong learning by giving them leadership skills, values, and knowledge. Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, which India adopted in 2015, aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by 2030, which is in line with the global agenda for development in education.

The University Grants Commission (UGC) has decided to implement the National Education Policy (NEP), 2020, by revising the curriculum across the nation. At SPPU, the Board of Studies in Zoology has updated the curriculum to include the policies and procedures mentioned in the NEP, 2020, which is going to be implemented from the academic year 2024 - 2025 in the colleges affiliated to Savitribai Phule Pune University. It covers a wide variety of fascinating subjects. The NEP aims to integrate general (academic) education, vocational education, skill based education and experiential learning to improve the effectiveness and holistic nature of education. The objective of NEP 2020 is to foster academic excellence, ease smooth academic mobility, and augment the global competitiveness of Indian students by instituting a credit structure and course framework that are both nationally and internationally equivalent. The NEP offers a comprehensive, multidisciplinary education program that will support students' intellectual, scientific, social, physical, emotional, moral, and ethical growth.

Students can select their areas of interest due to the curriculum's flexibility, which improves their employment opportunities. For students' development, the NEP 2020 guarantees adaptable curriculum framework and a course-based result strategy.

In reaction to the swift progress in science and technology as well as the changing perspectives in diverse fields of basic and applied Zoology, the Board of Studies in Zoology at SPPU, Pune framed the first year B. Sc. Zoology curriculum, which not only surpasses the confines of conventional academia but also transcends traditional academic boundaries. Students will have the freedom to tailor their course to interests and to specialise or maintain breadth in their studies. The range of research and transferable skills they will learn will enhance their employability as a graduate.

The students admitted for Zoology degree will acquire extensive disciplinary knowledge in the related branches of Zoology. The curriculum is not only designed to make the students capable of securing their career in Life science industries but also become capable of becoming potential entrepreneurs by starting their own business such as Vermiculture, Sericulture, Apiculture, Pet breeding and management, Dairy management, Aquarium management, Pest management, Laboratory animal breeding and management, Fishery management and marketing, Toxicology, etc. At the end of the program, students can possess skills that will give them a competitive advantage in pursuing higher studies in India and abroad as well as seeking a job. In an educational framework based on the learning outcomes

of the program, students are able to define and explain the main concepts of the life sciences. They will be familiar with a variety of biological instruments and appropriate laboratory techniques, impart biological knowledge in oral and written form, and identify the relationship between structure and function at all levels : molecular, cellular, tissue, organic, systemic, and organizational.

Students should be able to identify, classify, and distinguish a variety of non-chordate and chordate organisms based on their basic morphological, anatomical, biochemical, and molecular characters. They can also describe the economic, environmental, and medical importance of different animals in human life. This program inspires curiosity and awareness among students to learn more about the diversity of animals, and also pursue wildlife exploration as a career option. Procedural knowledge of animal identification and classification as well as various skill based courses will provide the students with professional advantages for seeking employment in teaching, research, and taxonomy in various public and private organizations. Students can apply scientific methods for answering questions in biology by formulating testable hypotheses, collecting data related to those hypotheses, and analyzing that data to evaluate the extent to which their scientific work supports their hypotheses.

The world's present scenario of drastic changes in the climatic conditions has resulted in total uncertainties of sustainable agricultural production and food security for human beings. Zoology will be the most promising branch for providing food and protein security for the ever increasing population in future as many insects, organisms and animals are important part of the human diet worldwide.

❖ Program Duration and Exit Options :

- The UG Program is of four years divided in eight semesters. Student may leave the program after third year if, they prefer to receive a three year graduate degree.
- If the student decides to exit after first year, they will receive a UG Certificate, if they decide to exit after Second year; they will receive a UG Diploma. This will also depend on the total required credits they had earned.
- Re-entry within three years to finish the degree program is allowed for those who had left with a UG Certificate or UG Diploma.
- A student must earn minimum 22 credits and a maximum 26 credits in each semester.

- The minimum number of credits required to be earned for award of Undergraduate Certificate / Undergraduate Diploma / Bachelor Degree / Bachelor's Degree with Honors in Zoology / Bachelor's Degree with Honors in Zoology with Research are as follows –

Sr. No.	Type of Award	Exit Stage	Mandatory Credits to be obtained
1.	Undergraduate Certificate in Zoology	After successful completion of First year i. e. Semester I & II	44
2.	Undergraduate Diploma in Zoology	After successful completion of Second year i. e. Semester III & IV	88
3.	Bachelor of Science in Zoology Major	After successful completion of Third year i. e. Semester V & VI	132
4.	Bachelor of Science in Zoology (Honors)	After successful completion of Fourth year i. e. Semester VII & VIII	176
5.	Bachelor of Science in Zoology (Honors) with Research	After successful completion of Fourth year i. e. Semester VII & VIII	176

❖ Eligibility Criteria :

- The criteria for F. Y. B. Sc. Zoology admission will be 10 + 2 passed students / MCVC / Diploma courses related to Animal Sciences / Life Sciences etc.
- Other conditions will be as prescribed by Savitribai Phule Pune University, Pune / Government of Maharashtra.

❖ Fee Structure :

As per the norms laid down by Savitribai Phule Pune University, Pune.

❖ Course Implementation criteria :

Each semester consisting of 15 weeks = 12 weeks for Actual Teaching + 3 weeks for Continuous Internal Evaluation.

I. **Two Credits of the Theory** = 30 clock hours (Actual Teaching of 2 hours per week + 3 hours for continuous internal evaluation which may consists of short questions, class tests, field visits, tutorials, problem solving sessions, practice, group discussion, assignments, unit tests, seminars, quiz, M. C. Q., project work etc.

II. **Two Credits of Practical** = 60 clock hours.

❖ Examination Pattern :

➢ Theory Paper of 02 Credits –

- Internal Exam (15 Marks) + University Theory Exam (35 Marks) = 50 Marks.
- Duration : For Internal exam = 40 Minutes, and For University Exam = 02 hours.

➢ Practical Paper of 2 Credits –

- Internal Exam (15 Marks) + University Practical Exam (35 Marks) = 50 Marks.
- Duration : For Internal exam = 40 Minutes, and For University Exam = More than 04 hours.

❖ Assessment Method (For each Semester) :

The examinations will be conducted after completion of each semester, both for Theory as well as Practical courses. Total marks for 2 credit course examination will be 50.

❖ Award of Class / Grade and A. T. K. T. Rules :

As per the norms and conditions laid down by SPPU, Pune.

❖ Important Instructions :

- ➢ There should be at least a short (1 day) and Distant (2-3 days) Study tour / Field visit / Industrial visit / Institutional visit per year.
- ➢ Tours are the part of curriculum and are mandatory to each student, failing which they will not be considered eligible to claim the marks assigned in the practical examination.
- ➢ The student has to submit the followings at the time of practical examination : Certified Journal, Certified Study tour report / Field visit report and Any other prescribed for the course.

❖ Question paper pattern for Theory (2 Credit courses) :

The students will have to solve the question paper of 35 marks. Including optional questions, The paper setter should set the paper on entire syllabus for total 61 marks,.

N. B. : All questions are compulsory.

Max. Time : 2 Hours.

Q. 1) Answer any five of the followings in one sentence - 05 Marks

- Attempt any five from six questions.

Q. 2 (a) Attempt any one of the following - 06 Marks

- Attempt any one from the two questions.

Q. 2 (b) Attempt any one of the following - 04 Marks

- Attempt any one from the two questions.

Q. 3 (a) Solve any one of the following - 06 Marks

- Solve any one from the two questions.

Q. 3 (b) Solve any one of the following - 04 Marks

- Solve any one from the two questions.

Q. 4) Write notes on (Any four) - 10 Marks

- Attempt any four from six questions.

Savitribai Phule Pune University, Pune

Credit Framework for Under Graduate (UG) (2024 - 25) (3 Subject) for faculty of Science and Technology

Level / Difficulty	Sem.	Subject – 1	Subject - 2	Subject - 3	GE / OE	SEC	IKS	AEC	VEC	CC	Total
4.5 / 100	I	2 (T) + 2 (P)	2 (T) + 2 (P)	2 (T) + 2 (P)	2 (T)	2 (T / P)	2 (T) (Generic)	2 (T)	2	--	22
	II	2 (T) + 2 (P)	2 (T) + 2 (P)	2 (T) + 2 (P)	2 (T / P)	2 (T / P)	--	2 (T)	2	2	22

Exit option : Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course / Internship OR Continue with Major and Minor

Continue option : Student will select one subject among the (subject 1, subject 2 and subject 3) as major and another as minor and third subject will be dropped.

Level / Difficulty	Sem.	Credits Related to Major				Minor		GE / OE	SEC	IKS	AEC	VEC	CC	Total
		Major Core	Major Elective	VSC	FP / OJT/ CEP									
5.0 / 200	III	4 (T) + 2 (P)	--	2 (T / P)	2 (FP)	2 (T) + 2 (P)	--	2 (T)	--	2 (T) (Major Subject Specific)	2 (T)	--	2	22
	IV	4 (T) + 2 (P)	--	2 (T / P)	2 (CEP)	2 (T) + 2 (P)	--	2 (P)	2 (T / P)	--	2 (T)	--	2	22
Exit option : Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor														
5.5 / 300	V	8 (T) + 4 (P)	2 (T) + 2 (P)	2 (T / P)	2 (FP/ CEP)	2 (T)	--	--	--	--	--	--	--	22
	VI	8 (T) + 4 (P)	2 (T) + 2 (P)	2 (T / P)	4 OJT	--	--	--	--	--	--	--	--	22
Total 3 Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option : Award of UG Degree in Major with 132 credits OR Continue with Major and Minor														
6.0 / 400	VII	6 (T) + 4 (P)	2 (T) + 2 (T/P)	--	4 (RP)	4 (RM) (T)		--	--	--	--	--	--	22
	VIII	6 (T) + 4 (P)	2 (T) + 2 (T/P)	--	8 (RP)	0			0	0	0	0	0	22
Total 4 Years		**64**	**16**	**8**	**22**	**22**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**176**
Four Year UG Honours with Research Degree in Major and Minor with 176 credits OR														
6.0 / 400	VII	10 (T) + 4 (P)	2 (T) + 2 (T/P)	0	0	4 (RM) (T)			0	0	0	0	0	22
	VIII	10 (T) + 4 (P)	2 (T) + 2 (T/P)	0	4 (OJT)	0			0	0	0	0	0	22
Total 4 Years		**72**	**16**	**8**	**14**	**22**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**176**
Four Year UG Honours Degree in Major and Minor with 176 credits														

Notes:

Abbreviation:

VSC: Vocational Skill Course, IKS: Indian Knowledge System, FP: Field Project, OJT: On Job Training, CEP: Community Engagement and Service, OE/OE: Generic Elective / Open Elective, SEC: Skill Enhancement Course, AEC: Ability Enhancement Course, VEC: Value Education Course, CC: Cocurricular Courses, T — Theory, P — Practical.

1. VSC, FP/OJT/CEP should be related to the Major subject.
2. OE is to be chosen compulsorily from faculty other than that of the Major.
3. SEC to be selected from the basket of Skill Courses approved by college.
4. Student has to choose three subjects from the same faculty in First Year and at the start of Second year he has to opt one subject as Major subject and one another subject as Minor subject and the last one subject will be dropped by the student. Therefore, the student after completion of three year will be awarded degree in Major and Minor subject.
5. Student cannot select a subject as major or minor other than the subjects taken in first year.
6. Frame each course having even number of credits such as 2 or 4 credit.
7. This UG credit structure is applicable for all the programme across all faculties, except the programmes required approval from apex bodies like AICTE, PCI, BCI, COA, NCTE, etc.

Credit Structure for F. Y. B. Sc. Zoology, Semester – I

Semester	Courses	Course Code	Course Title	Credits
I	Subject - 1	ZOO - 101 - T	Genetics and Medical Zoology - T	2
		ZOO - 102 - P	Practicals in Genetics & Medical Zoology - P	2
	Subject - 2		T + P	4
	Subject - 3		T + P	4
	GE / OE (Generic / Open elective) (Any One from the Basket)	OE - 101 - ZOO	Apiculture - T	2
		OE - 102 - ZOO	Pet Breeding & Management - T	2
	SEC (Skill Enhancement Courses) (Any One from the Basket)	SEC - 101 - ZOO	Vermiculture Management - T	2
		SEC - 102 - ZOO	Practicals in Advanced Vermitechnology - P	2
	IKS (Indian Knowledge System) (Generic)	IKS – 100 - T	Common to All - T	2
	AEC (Ability Enhancement Courses)	AEC - 101 - ENG	Common to All - T	2
	VEC (Value Education Course)	VEC - 101 - ENV	Common to All - T	2
	CC (Cocurricular Courses)	--	----------	0
Total				22

Credit Structure for F. Y. B. Sc. Zoology, Semester – II

Semester	Courses	Course Code	Course Title	Credits
II	Subject - 1	ZOO - 151 - T	Cell Biology and Biomedical Techniques - T	2
		ZOO - 152 - P	Practicals in Cell Biology & Biomedical Techniques - P	2
	Subject - 2		T + P	4
	Subject - 3		T + P	4
	GE / OE (Generic / Open elective) (Any One from the Basket)	OE - 151 - ZOO	Apiculture - P	2
		OE - 152 - ZOO	Wildlife Photography - P	2
	SEC (Skill Enhancement Courses) (Any One from the Basket)	SEC - 151 - ZOO	Dairy Production & Management - T	2
		SEC - 152 - ZOO	Practicals in Dairy Science - P	2
	IKS (Indian Knowledge System)	--	----------	0
	AEC (Ability Enhancement Courses)	AEC – 151 - ENG	Common to All - T	2
	VEC (Value Education Course)	VEC – 151- ENV	Common to All - T	2
	CC (Cocurricular Courses)	CC - 151	PE / NSS / NCC	2
Total				22

SEMESTER - I

ZOO - 101 - T : Genetics and Medical Zoology (T)						
Year : I				Semester : I		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures Per week	Internal Assessment	Semester End Exam	Total
Subject - 1	02	30	02	15	35	50

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Apply Mendelian genetic principles to predict outcomes of genetic crosses, interpret pedigrees and understand the basics of genetic inheritance.

CO2 : Recognize and explain the inheritance patterns and molecular basis of common genetic disorders, including both Mendelian and complex traits.

CO3 : Understand the concept of non - Mendelian genetics.

CO4 : Concept and characteristics of multiple alleles, ABO blood group system, Inheritance of Rh antigen, Erythroblastosis foetalis and their medicolegal importance.

CO5 : Understand the structure of chromosomes, chromatin and its types, giant chromosomes and chromosomal aberrations.

CO6 : Successfully solve genetic problems using Punnett squares, probability calculations and pedigree analysis.

CO7 : Understand basic concepts of medical zoology.

CO8 : Understand different epidemic, vector borne and microbial diseases in humans.

CO9 : Understand about investigations and treatments of human physiological disorders.

Detailed Syllabus:

Unit No.	Name of the Topic	Lectures Allotted
1.	**Recapitulation of Mendelian Genetics:** 1.1 Mendel's work: Selection of experimental plant.	02

	1.2 Mendelian Inheritance: Laws of heredity and their practical applications (Monohybrid cross and Dihybrid cross). 1.3 Test cross and back cross.	
2.	**Non-Mendelian Genetics:** 2.1 Concept of Gene Interaction: Intra-allelic interactions and Interallelic interactions. 2.2: Dominance and Co-dominance. 2.3 Inter-allelic interactions: Co-dominance and incomplete dominance (concept of epistasis, complimentary factors (9 : 7), supplementary factors (9 : 3 : 4), inhibitory factors (13 : 3), duplicate dominant genes (factors) (15 : 1). 2.4 Lethal genes in *Mus musculus*.	**03**
3.	**Multiple alleles:** 3.1 Concept and characteristics. 3.2 ABO blood group system, Inheritance of Rh antigen, Erythroblastosis foetalis and their medicolegal importance.	**02**
4.	**Chromosomes:** 4.1 Introduction: Morphology and types of chromosomes (based on the position of centromere and involvement in sex determination). 4.2 Chromatin, its structure and its types (Euchromatin and Heterochromatin). 4.3 Giant chromosomes (Polytene chromosome and Lamp brush chromosomes). 4.4 Chromosomal Aberrations: Structural (Deletion, duplication, inversion and translocation) and Numerical (Euploidy, monoploidy, polyploidy - auto polyploidy & allopolyploidy and aneuploidy - monosomy, nullisomy, trisomy).	**05**
5.	**Sex Determination:** 5.1 Genetically controlled sex determination: (Heterogametic males: XX - XY & XX - XO systems, Heterogametic females: ZZ - ZW system), Genetic balance system in *Drosophila*. 5.2 Parthenogenesis and Gynandromorphism.	**03**
6.	**Sex-linked Inheritance:** 6.1 Sex-linked inheritance: Characteristics, types (X - linked, Y - linked, and XY - linked).	**02**

	6.2 Examples of Sex-linked inheritance: Hemophilia, Colour blindness and Hypertrichosis.	
7.	**Introduction to Medical Zoology:** 7.1 Definitions: Parasitology, host, parasite, vector, symbiosis, commensalisms, mutualism, parasitism and zoonosis. 7.2. Branches of medical zoology: Medical Protozoology, Medical Helminthology, Medical Entomology.	**01**
8.	**Epidemic Diseases in Human:** Occurrence, causative organism, symptoms and eradication programs of the following: 8.1 Typhoid. 8.2 Cholera. 8.3 Small pox.	**03**
9.	**Vector Borne Diseases in Human**: Occurrence, causative organism, symptoms and eradication programs of the following: 9.1 Dengue. 9.2 Chicken Guinea. 9.3 Viral Influenza. 9.4 Scabies.	**03**
10.	**Microbial Diseases in Human:** Causative organism and clinical features of the following: 10.1 Tuberculosis. 10.2 Hepatitis. 10.3 AIDS.	**03**
11.	**Investigations and treatments of human physiological disorders:** 11.1 Angiography. 11.2 Angioplasty. 11.3 Dialysis.	**03**

Suggested Readings:

1. Genetics: Verma, P. S. and Agrawal, V. K., S. Chand and Co., New Delhi.
2. Fundamentals of Genetics: B. D. Singh, Kalyani Publishers, New Delhi.
3. Principle of Genetics: Sinnott, Dunn and Dobzhansky, Tata McGraw Hill Edition, New Delhi.

4. Genetics: Gupta, P. K., Rastogi Publication, Meerut.
5. Genetics: Sarin, C., Tata McGraw Hill, New Delhi.
6. Principles of Genetics: Gardner, E. J., Simmons, M. J. and Snustad, D. P., John Wiley and Sons.
7. Cytology and Genetics: Dyan Sagar V. R., Tata McGraw Hill Pub. Co. Ltd., New Delhi.
8. Baker, F. J. and Silverton, R. E. : Introduction to Medical Laboratory Technology, (6th ed.), Butler Worth and Co. Ltd.
9. Chatterjee, K. D. (1995), Parasitology, Protozoology and Helminthology (12th ed).
10. Cheesborough, M. (1987), Medical Laboratory Technology for Tropical countries (2nd ed.), Butler Worth and Co. Ltd.
11. Garcia, L. S. (2001), Diagnostic Medical Parasitology, (4th ed.), ASM Press, Washington.
12. Talib,V. H. (1999), Essential Laboratory Manual, Mehta Publishers, New Delhi.

ZOO - 102 - P : Practicals in Genetics and Medical Zoology (P)						
Year : I				Semester : I		
Teaching Scheme				Teaching Scheme		
Course Type	Credits	Number of Teaching hours	Practical per week	Internal Assessment	Semester End Exam	Total
Subject – 1	02	60	01	15	35	50

Course Outcomes :

After completion of this course, students should be able to :

CO1 : Calculate and interpret monohybrid, dihybrid, test and back cross ratios based on hypothetical data.

CO2 : Use collected data to understand the inheritance patterns of Mendelian traits.

CO3 : Identify and describe the chromosomal composition of a normal human karyotype.

CO4 : Perform blood typing and interpret blood group results.

CO5 : Perform to understand study of facultative heterochromatin from humans.

CO6 : Learn an experiment to know the structure of polytene chromosomes

CO7 : Learn various vector borne as well as protozoan diseases and their control measures.

CO8 : Learn scientific approach or techniques used in clinical laboratories to investigate

various diseases and will be skilled to work in research laboratories.

CO9 : Understand the human immune system and its response to the pathogen.

CO10 : Measurements of blood pressure under normal and stressed condition.

Detailed Syllabus:

Fifteen Practicals should be conducted from the following list (At least 8 Practical's from Genetics and seven practicals from Medical Zoology inclusive of the compulsory practicals).

Unit No.	Title of the Practical	Practical Allotted
1.	Experiments on monohybrid, dihybrid cross ratio and deducing the applicability of Mendelian laws (three examples of each ratio). **(E) (Compulsory)**	**1P**
2.	Experiments on test cross and back cross ratio and deducing the applicability of Mendelian laws (three examples of each ratio). **(E) (Compulsory)**	**1P**
3.	Experiment in multiple alleles, co dominance and epistatic interaction.	**1P**
4.	Study of chromosomal aberrations by use of pictures. **(D)**	**1P**
5.	Study of Mendelian genetic traits in human beings (tongue rolling, widow's peak, attachment of ear lobes and PTC tasters / non-tasters) using collected data from a limited population. **(E) (Compulsory)**	**2P**
6.	Preparation of normal and abnormal human karyotype from picture of metaphase chromosomal spread.	**1P**
7.	Study of colour blind by Isihara chart.	**1P**
8.	Study of blood groups in human. (ABO & Rh). **(E) (Compulsory)**	**1P**
9.	Study of facultative heterochromatin from humans: Barr body (buccal cells) / Drumstick (Neutrophils). **(E) (Compulsory)**	**1P**
10.	Study of polytene chromosomes from *Drosophila / Chironomous* larva / Housefly. **(E) (Compulsory)**	**1P**
11.	Examination of blood for presence / absence of the parasite. **(E) (Compulsory)**	**1P**
12.	**Study of vectors:** Mosquito (*Aedes, Culex, Anopheles*), Sand fly, Rat flea and Body louse. **(D) (Compulsory)**	**1P**

Unit No.	Title of the Practical	Practical Allotted
13.	**Epidemic diseases:** Occurrence, causative organism, symptoms and control measures of Typhoid, Cholera and Small Pox. **(D) (Compulsory)**	1P
14.	**Vector Borne diseases**: Occurrence, causative organism, symptoms and control measures of Dengue, Chicken Guinea and Scabies. **(D) (Compulsory)**	1P
15.	**Microbial diseases:** Occurrence, causative organism, clinical features and control measures of Tuberculosis, Hepatitis and AIDS. **(D) (Compulsory)**	1P
16.	Study of life history, mode of infection, pathogenicity, prophylaxis and treatment of *Plasmodium vivax.* **(D)**	1P
17.	Study of life history, mode of infection, pathogenicity, prophylaxis and treatment of *Taenia solium.* **(D)**	1P
18.	Study of life history, mode of infection, pathogenicity, prophylaxis and treatment of *Fasciola hepatica.* **(D)**	1P
19.	Principle and working of Angiography, Angioplasty, Dialysis. **(D) (Compulsory)**	1P
20.	Measurement of blood pressure under normal and stressed condition. **(E) (Compulsory)**	1P

OE - 101 - ZOO : Apiculture -T						
Year : I			**Semester : I**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
GE/OE (Generic/ Open Elective)	**02**	**30**	**02**	**15**	**35**	**50**

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Students will know about different species of honey bees and their diseases and enemies.

CO2 : Students will gain skill of rearing honey bees.

CO3 : Students will be able to apply knowledge of bee economy in setting up their own apiary and they can be entrepreneur in this field.

CO4 : Acquire knowledge about different species and casts of the honey bees.

CO5 : Aware about economic importance of honey bees.

CO6 : Identify role of honey bees in nature and in agricultural productivity.

CO7 : Understand the basics about beekeeping tools, equipment, and managing beehives.

CO8 : Acquire knowledge about distribution of species of honey bees.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	**Study of honey bees:** 1.1 Introduction. 1.2 Systematic Position, habit, habitat, distribution, marks of identification and nesting behavior of *Apis dorsata, Apis indica, Apis florae* and *Apis mellifera.* 1.3 Life cycle of honey bee, colony organization and division of labour.	**07**
2.	**Study of Behavior and Equipments:** 2.1 Bee behavior and communication - Round dance and Wag-tail dance. 2.2 Artificial bee rearing (apiary) : Beehives (Langstroth), Beekeeping and seasonal management. 2.3 Bee keeping equipments – Comb foundation sheet, Honey extractor, Uncapping knife, Smoker, Hive tool, Overall, Bee veil, Bee gloves, High boots, Bee brush, D. B. feeder. 2.4 Methods of extraction of honey. (Indigenous and Modern)	**10**
3.	**Study of Enemies and Diseases:** 3.1 Enemies of honey bee : Wax moth, Wax beetle, Wasps, Ants, Birds (Green bee eater, King crow), Amphibians and Mammals. 3.2 Bee diseases : Protozoan (Nosema), Bacterial (American foul brood), Viral (Sac brood), Fungal (Chalk brood). 3.3 Control and preventive measures of Bee diseases.	**07**

4.	**Bee economics and Marketing:** 4.1 Bee Economy : Products of apiculture industry and its uses - honey, bees wax, propolis, pollen, bee venom, royal jelly. 4.2 Bee pollination and management. 4.3 Entrepreneurship in Apiculture.	**06**

Suggested Readings :

1. Prost P. J. (1962) Apiculture, Oxford and IBH, New Delhi. ISBN No – 9781898298052.
2. Bisht D. S. (1984) Apiculture, Indian council of Agricultural Research, New Delhi.
3. Singh S. (1982) Beekeeping in India, Indian council of Agricultural Research, New Delhi.
4. Bees and Bee keeping in India, D.P. Abrol, Kaluani Publications.
5. Bees their vision, chemical senses & language-1950, Cornel University Press- By Fon firsh, & Karl.
6. The Social Behaviour of the Bees, 1974 : By Missioner C. D.
7. Beekeeping in India, 1962, 82, Sardar Singh, ICAR, New Delhi.
8. Bees and Bee Keeping Science, Prentice & World Resources, 1990 – Eva Crane, Heinemann Newnes, Oxford, UK.
9. The Hive and the Honey Bee 1992 (Revised Edition), J. Graham, Dadint & Sons Inc., Hamilton, USA.

OE - 102 - ZOO : Pet Breeding & Management - T						
Year : I			**Semester : I**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
GE/OE (Generic/ Open Elective)	**02**	**30**	**02**	**15**	**35**	**50**

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Understand the importance of pet animals and learn empathy towards animals.

CO2 : Understand expenditure and economics of pet breeding business.

CO3 : Enhance the skill of pet breeding.

CO4 : Get earning from pet breeding business.

CO5 : Get jobs in Toxicology and Pharmaceutical Industries.

CO6 : Save the vulnerable species of pet animals, maintain species balance in environment.

CO7 : Able to understand marketing strategies to boost sale of pets.

CO8 : Understand socio-economic importance of pets.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	**Introduction :** 1.1 Definition. 1.2 Why pet animals ? 1.3 Behavioral study of animals. 1.4 Types of pets. 1.5 Geographical distribution, morphological features and anatomy in brief.	**03**
2.	**Breeding Requirement :** 2.1 Breeding plan with budget. 2.2 Breeding ethics, license procedure and legal permissions. 2.3 Selection of site. 2.4 Selection of breeds. 2.5 Selection of nutritive feed.	**06**
3.	**Breeding Techniques :** 3.1 Reproduction cycle of selected breed. 3.2 Natural breeding method. 3.3 Prevention / termination of unwanted / unplanned pregnancies. 3.4 Artificial / selective / induced breeding techniques. 3.5 Precautions during gestation period to parturition of pet. 3.6 Post parturition care of mother and newborn pets, promoting positive interaction early in puppy's development. 3.7 Compliance with the relevant legislation and standards of care in	**08**

	their jurisdiction while marketing puppies. 3.8 Precautions to avoid over breeding stress in adult dogs. 3.9 Study of Prevention in Cruelty to Animals Act, 1960.	
4.	**Merits and demerits of Selective Breeding.**	**02**
5.	**Pet diseases and treatment :** 5.1 Common infectious diseases and their control measures. 5.2 Common non-infectious diseases and their control measures. 5.3 Pet care tips. 5.4 Preventing care for breeder from animal contact.	**06**
6.	**Socio-economic importance of pets.**	**02**
7.	**Pet marketing strategies to boost the sale :** 7.1 Create an engaging website for your pet-care business. 7.2 Market your pet-care business on social media. 7.3 Set up a referral system. 7.4 Host pet events. 7.5 Partner with a shelter to offer discounted services to newly adopted pets.	**03**

Suggested Readings :

1. Olden Broek K., Van Der Waaij L., Textbook Animal Breeding and Genetics for B. Sc. Students. Centre for Genetic Resources the Netherlands and Animal Breeding and Genomics Centre, 2015.
2. Pearson New International Edition Understanding Animal Breeding Richard M. Bourdon Second Edition.
3. The domestic dog its evolution, behaviour and interaction with people, James Serpell First edition, Cambridge University Press.
4. The complete bird owner's handbook Gary A. Callerstein, First edition, Howell book house, New York.
5. Canine Reproduction and Neonatology, A Practical Guide for Veterinarians, Veterinary Staff and Breeders, by Marthina L. Greer, DVM, JD., 2014; Teton New Media.

SEC - 101 - ZOO : Vermiculture Management – T						
Year : I			Semester : I			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
SEC (Skill Enhancement Courses)	02	30	02	15	35	50

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Acquire a critical knowledge on the role of earthworms in making organic matter from biodegradable wastes.

CO2 : Understand the biology of some important species of earthworms used in vermiculture.

CO3 : Acquire skills in production of vermicompost.

CO4 : Explain benefits and problems with vermiculture and vermicompost.

CO5 : Become an entrepreneur by culturing earthworms.

CO6 : Acquire a knowledge about life cycle of earthworm.

CO7 : Understand economics importance of earthworm.

CO8 : Identify enemies and diseases of earthworm.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	**Introduction to vermiculture :** 1.1 Definition, history and its importance in maintenance of soil structure. 1.2 Role of vermiculture in four R's of recycling (Reduce, Reuse, Recycle and Restore). 1.3 The matter and humus cycle (product, qualities) of earthworm. 1.4 Transformation process in organic matter.	05
2.	**Types of earthworms :** 2.1 Types of earthworms - Epigenic, Endogenic and Anecic.	05

	2.2 Indigenous species of earthworms. 2.3 Exotic species of earthworms. 3.4 Useful species of earthworm: *Eisenia foetida, Eudrilus eugeniae, Lumbricus rubellus, Perionyx excavates* etc.	
3.	**Biology of Earthworm (*Eisenia foetida* or *Eudrilus eugeniae*) :** 3.1 Systematic position, External Morphology, Habit & Habitat. 3.2 Life cycle of *Eisenia foetida* or *Eudrilus eugeniae.* 3.3 Digestive system of *Eisenia foetida* or *Eudrilus eugeniae.* 3.4 Reproductive system of *Eisenia foetida* or *Eudrilus eugeniae.*	**06**
4.	**Vermicomposting :** 4.1 Small scale farming for house gardens. 4.2 Conventional commercial composting / Large scale earthworm farming - Pit system, Heap system, Bricksy stem, Kadapas lab method. 4.3 Earthworm - Feeding and Maintenance. 4.4 Vermicompost harvest, processing and packaging. 4.5 Vermi-wash preparation, composition, collection & uses.	**09**
5.	**Enemies and diseases of Earthworms :** 5.1 Enemies of Earthworm – Ants, Birds, Rats, Snakes, Toads. 5.2 Diseases of Earthworm – Bacterial, Protozoan, Fungal.	**03**
6.	**Economics and marketing :** 6.1 Economic importance of earthworms, vermicompost and vermiwash. 6.2 Vermicompost as business / marketing of vermicompost, employment opportunities.	**02**

Suggested Readings :

1. Bhatt J. V. & S. R. Khambata (1959) “Role of Earthworms in Agriculture” Indian Council of Agricultural Research, New Delhi.
2. Edwards, C. A. and J. R. Lofty (1977) “ Biology of Earthworms ” Chapman and Hall Ltd., London.
3. Lee, K. E. (1985) “ Earthworms : Their ecology and Relationship with Soils and Land Use ” Academic Press, Sydney.
4. Wallwork, J. A. (1983) “ Earthworm Biology ” Edward Arnold (Publishers) Ltd. London.

5. Kevin, A and K. E. Lee (1989) " Earthworm for Gardeners and Fisherman " (CSIRO, Australia, Division of Soils).
6. The Complete Technology Book on Vermiculture and Vermicompost. by NPCS board. Asis Specific Business Press.
7. Singh K, Nath G, Shukla RC and Bhartiya DK (2014) Textbook of Vermicompost: Vermiwash and Biopesticides.
8. Panda H (2022) Vermiculture and Vermicompost (Earthworm) with Manufacturing Process, Machinery Equipment Details & Plant Layout.

SEC - 102 - ZOO : Practicals in Advanced Vermitechnology - P						
Year : I			Semester : I			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Practical per week	Internal Assessment	Semester End Exam	Total
SEC (Skill Enhancement Courses)	02	60	01	15	35	50

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Acquire a knowledge on role of earthworms in making vermicompost.

CO2 : Understand the internal structure of species of earthworms used in vermiculture.

CO3 : Acquire skills on production of vermicompost.

CO4 : Able to prepare small scale and large-scale vermicomposting units.

CO5 : Become an entrepreneur by culturing earthworms.

CO6 : Understand methods of vermiculture.

CO7 : Acquire knowledge to sale different vermiculture products.

CO8 : Able to prepare and maintain of vermicomposting unit.

Detailed Syllabus :

Unit No.	Title of the Practical	Practical Allotted
1.	Identification of earthworm species using standard key. **(D)**	1P
2.	Study of systematic position, habits, habitat & external characters of	1P

	Eisenia foetida or Eudrilus eugeniae. **(D) (Compulsory)**	
3.	Study of life stages and development of *Eisenia foetida or Eudrilus eugeniae.*	**1P**
4.	Study of vermiculture, vermiwash & vermicompost equipment's and devices. **(D) (Compulsory)**	**1P**
5.	Preparation and maintenance of vermicomposting methods : Bed method and pit method. **(E)**	**2P**
6.	Harvesting, packaging, transport and storage of vermicompost. **(D)**	**2P**
7.	Preparation of vermiwash. **(E)**	**2P**
8.	Study of earthworm diseases & enemies. **(E) (Compulsory)**	**2P**
9.	To study the effects of vermicompost & vermiwash on any two short duration crop plants. **(E)**	**2P**
10.	To Study the effects of sewage water on development of earthworms. **(E)**	**2P**
11.	Marketing of vermicompost and vermiwash. **(E)**	**2P**
12.	Compulsory visit to local vermicomposting unit and preparation of project report on vermicomposting.	**2P**

Suggested Readings :

1. Bhatt J. V. & S. R. Khambata (1959) " Role of Earthworms in Agriculture " Indian Council of Agricultural Research, New Delhi.
2. Edwards, C. A. and J. R. Lofty (1977) " Biology of Earthworms " Chapman and Hall Ltd., London.
3. Lee, K. E. (1985) " Earthworms : Their ecology and Relationship with Soils and Land Use " Academic Press, Sydney.
4. Wallwork, J. A. (1983) " Earthworm Biology " Edward Arnold (Publishers) Ltd. London.
5. Kevin, A and K. E. Lee (1989) " Earthworm for Gardeners and Fisherman " (CSIRO, Australia, Division of Soils).
6. The Complete Technology Book on Vermiculture and Vermicompost. by NPCS board. Asis Specific Business Press.
7. Singh K, Nath G, Shukla RC and Bhartiya DK (2014) Textbook of Vermicompost: Vermiwash and Biopesticides.

8. Panda H (2022) Vermiculture and Vermicompost (Earthworm) with Manufacturing Process, Machinery Equipment Details & Plant Layout.

IKS - 100 - T : Common to All - T						
Year : I			Semester : I			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
IKS (Indian Knowledge System) (Generic)	02	30	02	15	35	50

AEC - 101 – ENG : Common to All - T						
Year : I			Semester : I			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
AEC (Ability Enhancement Course)	02	30	02	15	35	50

VEC - 101 - ENV : Common to All - T						
Year : I			Semester : I			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
VEC (Value Education Course)	02	30	02	15	35	50

END OF THE SEMESTER - I

SEMESTER - II

ZOO - 151 - T : Cell Biology and Biomedical Techniques (T)						
Year : I				Semester : II		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Subject - 1	02	30	02	15	35	50

Course Outcomes:

After the completion of the course, students should be able to:

CO1 : Demonstrate the knowledge of cell diversity.

CO2 : Explain the cell membrane, cell – cell interactions and its dynamics.

CO3 : Understand nuclear structure and cell organelles.

CO4 : Explain mitochondria and its functions.

CO5 : Understand cytoskeleton and its functions.

CO6 : Understand safety protocols, ethical standards, professional conduct and best practices.

CO7 : Know about the biomedical instruments, their functioning and principle of operation.

CO8 : Apply immunological techniques for the detection of antigens, antibodies, and immune responses in disease diagnosis.

CO9 : Understand and perform hematological tests and diagnose common hematological Disorders and interpret urine analysis data.

Detailed Syllabus:

Unit No.	Name of the Topic	Lectures Allotted
1.	**Overview of cells :** 1.1 Prokaryotic (*E. coli*) and Eukaryotic (Plant & Animal) cells. 1.2 Microscopy – Simple and compound microscope. 1.3 Micrometry. 1.4 Types of Stains: Acidic, basic and neutral.	02

2.	**Plasma membrane:** 2.1 Models of plasma membrane. 2.2 Transport across membranes: Active and passive transport, facilitated transport, endocytosis, exocytosis. 2.3 Cell – Cell Junction, Structure and function, tight junctions, adherent junctions, gap junctions, desmosomes and hemi-desmosomes.	**03**
3.	**Cell organelles: Structure and functions -** 3.1 Nucleus and nuclear pore complex. 3.2 Endoplasmic reticulum. 3.2 Golgi complex. 3.3 Lysosomes. 3.4 Ribosome. 3.5 Peroxisomes. 3.6 Mitochondria.	**06**
4.	**Cell Division:** 4.1 Cell cycle. 4.2 Mitosis. 4.3 Meiosis.	**04**
5.	**Introduction and scope of biomedical techniques :** 5.1 Lab safety techniques and sterilization.	**01**
6.	**Laboratory instruments: Introduction, principle and working :** 6.1 Centrifugation. 6.2 Chromatography. 6.3 Spectroscopy. 6.4 Electrophoresis. 6.5 Microtomy.	**04**
7.	**Biomedical Instruments: Introduction, principle & brief working of :** 7.1 Electrocardiography (ECG). 7.2 Ultrasound / Sonography. 7.3 Polymerase chain reaction (PCR).	**03**
8.	**Clinical Techniques: Introduction and working principle.** 8.1 Blood collection. 8.2 Anticoagulants.	**04**

	8.3 Preparation and staining of blood smears. 8.4 Differential leucocyte count. 8.5 Hemocytometry (RBC and WBC). 8.6 Hemoglobin estimation.	
9.	**Urine analysis:** 9.1 Collection of urine sample. 9.2 Preservation of urine sample. 9.3 Routine urine analysis – Physical, bio-chemical and microscopic examination.	**03**

Suggested Readings:

1. Cell Biology: Verma, P. S. And Agrawal, V. K., S. Chand and Co., New Delhi.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J. D., Molecular Biology of the Cell, Gerl and Publ. Inc., New York, 2008.
3. Becker, W. M., Kleinsmith, L. J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Cooper, G. M. and Hausman, R. E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D. C.; Sinauer Associates, M. A.
5. De Robertis, E. D. P. and De Robertis, E. M. F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
7. Powar, C. B.: Cell Biology, Himalaya Publishing House, Bombay, 1999.
8. Bioprocess engineering basic concepts, Second Edition, by Michael L. Shuler & Fikret Kargi, 2002 published by Prentice Hall PTR.
9. Biotechnology procedures and experiments hand book, S. Harisha, Infinity Science Press 2007.
10. Principles and techniques of biochemistry and molecular biology, Seventh Edition, Keith Wilson and John Walker, Cambridge University Press, 2010.

ZOO - 152 - P : Practicals in Cell Biology and Biomedical Techniques (P)						
Year : I				Semester : II		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Practical per week	Internal Assessment	Semester End Exam	Total
Subject - 1	02	60	01	15	35	50

Course Outcomes:

After completion of this course, students should be able to:

CO1 : Learn to visualize animal and plant cells under microscope.

CO2 : Understand principles and workings of simple, compound microscopes.

CO3 : Acquire the skills to accurately measure microscopic objects using micrometry.

CO4 : Staining and visualization of mitochondria by Janus green stain.

CO5 : Estimate Hemoglobin using Sahli's haemometer.

CO6 : Perform RBC count in blood by using hemocytometer.

CO7 : Perform WBC count in blood by using hemocytometer.

CO8 : Study of human blood smear to observe different types of blood cells.

CO9 : Study of principle & working of Spectrophotometer, PCR and ECG.

CO10 : Work as a laboratory technician to do urine analysis - normal and abnormal constituents.

Detailed Syllabus:

Fifteen Practicals should be conducted from the following list (At least 8 Practical's from Cell Biology and 7 practicals from Biomedical Techniques inclusive of the compulsory practicals).

Unit No.	Name of the Practical	Practical Allotted
1.	Visualization of animal cells. **(E) (Compulsory)**	1P
2.	Visualization of plant cells. **(E) (Compulsory)**	1P
3.	Study of principle and working of simple and compound microscope. **(D)**	1P
4.	Measurement of microscopic objects using micrometry**. (E) (Compulsory)**	1P
5.	Identification of ultrastructure of different cell organelles from electron micrographs / video. (D)	2P
6.	Staining and visualization of mitochondria by Janus green stain. **(E) (Compulsory)**	1P

7.	Study of permanent slides of mitosis and meiosis. (D)	**1P**
8.	Preparation of temporary stained squash of onion root tip to study various stages of mitosis. **(E) (Compulsory)**	**1P**
9.	Preparation of temporary stained squash of onion root tip to study various stages of meiosis. (E)	**1P**
10.	Visualization of nuclear fraction by acetocarmine stain. (E)	**1P**
11.	Lab safety techniques and sterilization. (D)	**1P**
12.	Study of principle and working of centrifugation and chromatography. (D)	**1P**
13.	Study of principle and working of spectroscopy, electrophoresis and microtomy. (D)	**1P**
14.	Study of the principle of ECG, ultrasound / sonography, PCR. (D)	**1P**
15.	Hemoglobin estimation using Sahli's haemometer. **(E) (Compulsory)**	**1P**
16.	Differential Leucocyte Count. **(E) (Compulsory)**	**1P**
17.	Total RBC count in blood by using hemocytometer. (E)	**1P**
18.	Total WBC count in blood by using hemocytometer. (E)	**1P**
19.	Urine analysis - Normal and abnormal constituents. **(E) (Compulsory)**	**1P**
20.	Uric acid crystal examination in urine. **(E) (Compulsory)**	**1P**

OE - 151 - ZOO : Apiculture - P						
Year : I			**Semester : II**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Practical per week**	**Internal Assessment**	**Semester End Exam**	**Total**
GE/OE (Generic/ Open Elective)	**02**	**60**	**01**	**15**	**35**	**50**

Course Outcomes:

After completion of this course, students should be able to:

CO1 : Students will know about different species of honey bees and their diseases and enemies.

CO2 : Students will gain skill of rearing honey bees.

CO3 : Students will be able to apply knowledge of bee economy in setting up their own apiary and they can be entrepreneur in this field.

CO4 : Acquire knowledge about different species and casts of the honey bees.

CO5 : Aware about economic importance of honey bees.

CO6 : Identify role of honey bees in nature and in agricultural productivity.

CO7 : Understand the basics about beekeeping tools, equipment, and managing beehives.

Detailed Syllabus :

Unit No.	Name of the Practical	Practical Allotted
1.	Identification and study of honey bee species. (*Apis dorsata, Apis indica, Apis florae, Apis mellifera*) **(D)**	**2P**
2.	Study of life cycle of honey bee. **(D) (Compulsory)**	**1P**
3.	Study and identification of caste in honey bee. **(D)**	**1P**
4.	Study of Langstroth box. (Modern bee hive) **(D)**	**1P**
5.	Study of bee keeping equipments. **(D) (Compulsory)**	**2P**
6.	To study the seasonal management of apiary. **(D)**	**2P**
7.	Temporary mounting of legs, sting apparatus and poison gland, wings, mouth parts of worker bee. **(E) (Compulsory)**	**2P**
8.	Estimation of reducing sugars from honey. **(E) (Compulsory)**	**2P**
9.	Study of honey bee diseases. Protozoan (Nosema), Bacterial (American foul brood), Viral (Sac brood), Fungal (Chalk brood). **(D)**	**1P**
10.	Specimen study of honey bee predators and enemies: Wasps, Frogs / Toads, Bee eating birds (Geen bee eater or King crow), Pine Marten, Bear. **(D)**	**1P**
11.	Study of chemical composition and economic importance of honey bee products: Honey, pollen, propolis, bee wax, royal jelly, bee venom. **(D)**	**2P**

OE - 152 - ZOO : Wildlife Photography - P						
Year : I			**Semester : II**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Practical per week**	**Internal Assessment**	**Semester End Exam**	**Total**
GE/OE (Generic/ Open Elective)	**02**	**60**	**01**	**15**	**35**	**50**

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Organize better photographic documentation of their fields of discipline for classroom presentations and other records.

CO2 : Create opportunities to work in the field of nature and wildlife photo journalism and to earn by preparing photo-assignments for renowned nature and wildlife photo magazines and books.

CO3 : Promote and inculcate the values of art in the age of science, technology and mass media.

CO4 : Understand the camera menu, basic buttons and settings PS : Open, Close, Rate and Save.

CO5 : Able to shoot flowers, trees, and other steady things. shooting insects, birds, wildlife, and moving objects.

CO6 : Edit photographs by using various software.

CO7 : Able to resize & can apply border to images.

CO8 : Use various flashes to enhance photography results.

CO9 : Approach wild animals in their natural environment whether at home or abroad camera settings to achieve correctly exposed images.

Detailed Syllabus :

Unit No.	Title of the Practical	Practical Allotted
1.	Study of different types of cameras : DSLR, video camera, action camera and camera traps, infrared transmitters and receivers. **(D)**	**2P**
2.	Study of detail menu settings of DSLR camera. **(D)**	**1P**
3.	Study of controlling light with exposure value, shutter speed, aperture and ISO. **(D)**	**1P**
4.	On-field training on image composition. **(E) (Compulsory)**	**2P**
5.	Study of type of lenses, different methods of focusing, and depth of the field. **(D)**	**2P**
6.	Study of flash use and additional artificial lights.	**1P**
7.	On field training of macro and landscape photography. **(E) (Compulsory)**	**2P**
8.	On field photography of insects, birds, animals, trees and flowers. **(E)**	**1P**

	(Compulsory)	
9.	Installation and use of photo editing software : photoshop, lightroom, etc. **(D)**	**2P**
10.	To study the file formats and selection of appropriate one : crop and align horizon.	**1P**
11.	Demonstration of resizing and bordering images, selection tools, use of layers, and writing texts.	**1P**
12.	Compulsory field visit to Wildlife Sanctuary / National Park / Zoo, report writing and submission.	**3P**

SEC - 151 - ZOO : Dairy Production & Management - T						
Year : I			**Semester : II**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
SEC (Skill Enhancement Courses)	**02**	**30**	**02**	**15**	**35**	**50**

Course Outcomes :

After the completion of the course, students should be able to :

CO1 : Farming aspects in livestock so as to prepare themselves for future prospectus.

CO2 : Study of various diseases & disorders in livestock.

CO3 : Processing of market milk in dairy plant.

CO4 : Understand methods of manufacture and uses of standardized special milk.

CO5 : Learn methods of manufacture and uses of special milk of plants/vegetable origin.

CO6 : Understand the Milk collection, transportation, Grading, weighing and cooling of milk.

CO7 : Learn sterilization processes of equipments.

CO8 : Establish a farm and a processing unit.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	**General management practices in dairy farming :** Grooming, drying off, control of bad habits, castration, dehorning, trimming, shoeing, identification marks, removing extra teats, shearing.	**05**
2.	**Cattle and Buffalo Management :** Housing of cattle & buffalo, calf management, heifer management, management of pregnant and lactating cow & buffalo, care and management of cross – breed cows, care and management of breeding buffalo.	**07**
3.	**Factors affecting quality and quantity of milk, adulteration of milk, packaging and packaging material.**	**04**
4.	**Disease of Lactating cow :** Mastitis, dystocia, milk fever, prolapse, ketosis.	**04**
5.	**Dairy Processing :** 5.1 Milk collection, transportation, grading, weighing and cooling of milk. 5.2 Strainer and straining of milk. 5.3 Filter and filtration of milk. 5.4 Clarifier and clarification of milk. 5.5 Cream separator and separation. 5.6 Standardization. 5.7 Pasteurization : History, formulation standards types, FDV. 5.8 Regeneration efficiency. 5.9 Homogenization: Single & double stage homogenization, theory of homogenization, Homogenizer valve, homogenization efficiency. 5.10 Sterilization: Bottle, UHT, aseptic packaging.	**10**

Suggested Readings:

1. A Text book of Animal Husbandry by - G. C. Banarjee

2. A Text Book of Animal Science by - Dr. A. U. Bhikane and Dr. S. B. Kawitkar
3. Advances of animal Husbandry, The I. C. A. R. publication.
4. Animal Husbandry & Dairy Science by. Jagdish Prasad.
5. Dairy India Year Book – 2007 by - P.R. Gupta
6. Handbook of Veterinary Physician by V.A. Sarpe
7. Farm Animal Management and feeding practices in India by Thomas.
8. Outlines of Dairy Technology by Sukumar De.
9. Dairy Processing by Earl.
10. Dairy Technology and Engineering by H.G. Kessler
11. Dairy Plant Engineering and Management by Tuffel Ahmed.
12. Textbook of Dairy Plant Layout & Design by Lalat Chander,
13. Principles of Dairy Chemistry by Jenners and Pattorn.
14. Dairy Chemistry by M.M. Rai.
15. Dairy Microbiology by K.C. Mahanta.
16. Dairy management in India – Madan Mohan.
17. Text Book of Animal Husbandry – G.C. Banerjee.
18. Principles and practices of Dairy Farm – Jagdish Prasad.

SEC - 152 - ZOO : Practicals in Dairy Science - P						
Year : I			Semester : II			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
SEC (Skill Enhancement Courses)	02	60	01	15	35	50

Course Outcomes :

After completion of the course, students should be able to :

CO1 : Estimate fat, SNF, specific gravity of milk.

CO2 : Estimate acidity, surface tension, viscosity of milk.

CO3 : Understand standardization, pasteurization, sterilization of milk.

CO4 : Understand preparation of toned milk, double toned milk and reconstituted milk.

CO5 : Understand separation of cream and quality of given milk sample.

CO6 : Learn various types of breeds of cattle.

CO7 : Acquire knowledge about equipments use in dairy industry.

CO8 : Explore a small scale dairy business.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
1.	Preparation of project reports for various sizes of dairy farm.	**2 P**
2.	Study of Cattle Breeds (Any 5) – **(D)** a) Milch : Gir, Sahiwal, Red Sindhi. b) Draught : Khillar, Dangi, Red Kandhari. c) Dual : Deoni, Hariyana. d) Exotic : Jersey, H.F. e) Cross breed : Holdeo, Jerdeo.	**2 P**
3.	Study of buffalo breeds : Murratia, Jaffrabadi, Nagpuri, Surti.	**2 P**
4.	To determine specific gravity of milk, acidity and pH of milk. **(E) (Compulsory)**	**1 P**
5.	To study the fat determination test of milk. **(E) (Compulsory)**	**2 P**
6.	Study of milk collection equipments. **(E) (Compulsory)**	**2 P**
7.	Study of filter, strainer, clarifier. **(E) (Compulsory)**	**2 P**
8.	Study of cream separator. **(D)**	**2 P**
9.	Sterilization of milk. **(D)**	**2 P**
10.	Compulsory visit to Modern Dairy Farm & report submission.	**3 P**

AEC - 151 - ENG : Common to All - T						
Year : I			**Semester : II**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
AEC (Ability Enhancement Courses)	**02**	**30**	**02**	**15**	**35**	**50**

VEC - 151 – ENV : Common to All - T						
Year : I				Semester : II		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
VEC (Value Education Course)	02	30	02	15	35	50

CC - 151: PE / NSS / NCC						
Year : I				Semester : I		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Co- curricular	02	30	02	15	35	50

END OF THE SEMESTER - II