MODERN COLLEGE OF ARTS, SCIENCE AND COMMERCE GANESHKHIND, PUNE-16 (AUTONOMOUS)

SYLLABUS OF THIRD YEAR B.Sc ZOOLOGY

T.Y.B.Sc (SEMESTER V AND VI)

To be implemented from

Academic Year 2025-2026

FRAMED BY

BOARD OF STUDIES IN ZOOLOGY

Progressive Education Society's
MODERN COLLEGE OF ARTS, SCIENCE AND COMMERCE,
GANESHKHIND,
PUNE- 16
(AUTONOMOUS)

PREAMBLE:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in Life Sciences.

This under-graduate degree program has been designed by the Board of Studies in Zoology of Savitribai Phule Pune University with a substantial component of what is needed from a zoologist as a skilled career and what zoologists needs to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects in Zoology with the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Skill Enhancement Courses **[SEC**] have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Language & communication, English / Marathi, Aquarium Management, Poultry Management and Environmental Impact Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field visits, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

The new course will be effective from the academic year 2025- 2026 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of

B. Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing pre requisites of the students. This graduate program has been introduced with 144 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, co-curricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students.

The calculation of credits and CGPA will be as per the guidelines of the University. The B. Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills. The Syllabus has been revised with the following aims -

• To foster curiosity in the students for Zoology,

• To create awareness amongst students for the basic and applied areas of Zoology,

• To orient students about the importance of abiotic and biotic factors of environment and their conservation,

• To provide an insight to the aspects of animal diversity,

• To inculcate good laboratory practices in students and to train them about proper handling of lab instruments.

Instructions for the Students:

The students seeking admission to T.Y.B.Sc Zoology course is hereby informed that they are supposed to adhere to the following rules:

1. A minimum of 75 % attendance for lectures / practical is the pre-requisite for grant of term.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers / seminar / industrial visits/Field Visit / training course/viva-voce as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be permitted to the student absent for the test/s unless the case is considered by competent authority.
3. The students opting for dissertation course shall follow the rules framed for the same.

4. The students are supposed to attend all the Industrial Workshops / Laboratory Workshops / Training Programme/ symposia/ seminar/ field visit / study tour organized by the department/ college. The students shall attend these programmes at their own cost.

Examination

[A] Pattern of Examination Evaluation of Students:

1) The In-semester and End-Semester examinations will be of 20 marks each for 2 credits and 40 marks for 4 credits and for End-semester 30 marks for 2 credits and 60 marks for 4 credits.

2) Student has to obtain minimum of 40 % passing separately in both the In-Semester and End- Semester.

3) Internal marks remain unchanged and internal assessment cannot be repeated. If student remain absent during internal assessment examination, he/she will have second chance with the permission of the competent authority. But it will not be right of the student. It will be under the discretion of the competent authority and internal departmental assessment committee. In case he/she wants to repeat Internal, he/she can do so only by registering for the said courses.

5) There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

i. In-semester Examination:

Internal assessment for each course would be continuous and dates for each tutorials/practical tests etc. will be pre-notified in the time table for teaching or placed separately as a part of time table. Department / College Internal Assessment Committee will coordinate this activity.

a) Theory Courses:

Students should be encouraged to participate in various academic activities. A teacher must select a variety of the procedures for conducting internal assessment suggested as follows.

a) Multiple choice questions

b) Combination of objective and subjective questions.

c) Open book test (concerned teacher will decide the allowed books)

d) Tutorial

e) Surprise test specified topics in a given notified period

f) Oral

g) Assignments

h) Review of research paper

i) Seminar presentation

j) Journal/Lecture/Library notes Student has to preserve the documentation of the internal assessment except midterm test answer script. It is the responsibility of the student to preserve the documents.

b) Practical Courses:

It is a continuous evaluation process. Practical courses will be evaluated on the basis of the following:

1. Performance assessment of each experiment on the basis of attendance, punctuality, journal completion, practical skills, results, oral and analysis.
2. Assessment on practical course be conducted before the end-semester examination.
3. Assessment of each experiment shall be done for each practical weekly.
4. Assessment of the Activity will be based on any one of the following (per practical course).

i. Special training programs in recognized research institutes such as NCL, NIO, NIV, ZSI, BNHS, etc.

ii. Project on Research Methodology

iii. Industrial/Institution Visit report

iv. Field visit report/ study tour report.

The student strength of practical batch should be 12

Project Course: Project will be evaluated by the examiner/s in consent with the project guide if required.

ii. End-Semester Examination:

The End-semester examination program will be scheduled as per the notifications and guidelines issued by the Examination section of University of Pune.

[B] Standard of Passing

Student has to obtain 40% marks separately in In-Semester and End-Semester assessment.

Program outcomes (POs):

After successfully completing the T.Y.B.Sc Zoology program students will be able to:

PO1. Zoology knowledge: Apply the knowledge of Zoology, Life Sciences and allied subjects to the understanding of complex life processes and phenomena.

PO2. Problem analysis: Identify, review research literature, and analyse complex situations of living forms.

PO3. Design/development of solutions: Design processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge andresearch methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in real situations.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources,and ICT tools for understanding of the subject.

Programme Specific outcomes

PSO1: Understand the impact of the natural and anthropogenic activities in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. Identify a range of invertebrates and vertebrates and justify their conservation.

PSO2: Apply ethical principles and commit to professional ethics and responsibilities andnorms of the work/research practice.

PSO3: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Structure: **Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology- B.Sc. in Zoology**

T.Y. B.Sc.

Course Type	Course Code	SEMESTER V	Course Code	SEMESTER VI	Credits
Mandatory Major	ZOO35101	Biological chemistry (2C) (T)	ZOO36101	Molecular Biology (2C) (T)	2+2
Mandatory Major	ZOO35102	Entomology (2C) (T)	ZOO36102	Parasitology (2C) (T)	2+2
Mandatory Major	ZOO35103	Environmental Resource Management (2C) (T)	ZOO36103	Developmental Biology (2C) (T)	2+2
Mandatory Major	ZOO35104	Practical in Biological Chemistry (2C)(P)	ZOO36104	Practical in Molecular Biology (2C)(P)	2+2
Mandatory Major	ZOO35105	Practical in Environmental Resource Management (2C)(P)	ZOO36105	Practicals in Parasitology & Developmental Biology (2C)(P)	2+2
Major Elective	ZOO35106	Bioinstrumentation and Bioinformatics (2C)(T)	ZOO36106	Medical and Forensic Zoology (2C) (T)	2+2
Major Elective	ZOO35107	Practical in Bioinstrumentation and Bioinformatics (2C)(P)	ZOO36107	Practical in Medical and Forensic Zoology (2C)(P)	2+2
Minor	ZOO35208	Biodiversity, Conservation and sustainable development (2C) (T)	ZOO36208	Museology and Taxidermy of Invertebrates and Vertebrates (2C) (T)	2+2
Minor	ZOO35209	Practical in Biodiversity, Conservation and sustainable development(2C) (P)	ZOO36209	Practical in Museology and Taxidermy of Invertebrates and Vertebrates (2C) (P)	2+2
VSEC	ZOO35410	Practical in Entomology (2C) (P)		--	2
FP	ZOO35611	Field project (2C)	ZOO36610	OJT (4C)	2+4
				Total credits	44

Subject Code: - ZOO35101 Subject Name -: Biological Chemistry No. of credits: 02						
Year : III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

CO1: To understand the basic concepts and significance of biochemistry.

CO2: To know the basic concepts pH and Buffers.

CO3: To learn the chemical structures of carbohydrates, their biological and clinical significance.

CO4: To analyse the structure and importance of proteins and lipids.

CO5: To understand the variations in enzyme activity and kinetics.

Sr. No	Name of the Topic	Lectures allotted
1	**Unit 1:- Introduction of Biochemistry:** Importance of Biochemistry in Life Sciences	(01L)
2	**Unit 2 :- pH and Buffers** 2.1 Concept of pH. 2.2 Concept of pH scale, biological significance of pH 2.3 Concept of acid and base, Ionization of acids and bases. 2.4 Derivation of Henderson-Hassel Balch equation & its applications.	(03L)

	Buffer - Definition, Concept, Functions, Types of buffer and Buffering Capacity.	
3	**Unit 3 :- Carbohydrates** 3.1 Definition, Classification & Biological importance of Carbohydrates. 3.2 Isomerism in carbohydrates - Structural and Stereoisomerism. 3.3 Significance of Gluconeogenesis, Glycogenolysis and Glycogenesis. 3.4 Clinical significance- hyperglycaemia and hypoglycaemia	(06L)
4	**Unit 4 :- Amino acids and Proteins** 4.1 General Structure of amino acids and Peptide bond. 4.2 Essential, non-essential and conditionally essential amino acids. 4.3 Types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example) 4.4 Biological importance of proteins – Biocatalysts, Carrier proteins Contractile proteins, Hormonal role of proteins.	(06L)
5	**Unit 5:- Enzymes** 5.1 Nomenclature, Types and properties of enzymes. 5.2 Regulatory and non-regulatory enzymes. 5.3 Enzyme inhibition. 5.4 Factors influencing enzyme activity (pH, temperature, substrate concentration). 5.5 Introduction of isoenzymes and cofactor. 5.6 Clinical significance of enzymes - PKU and AKU. 5.7 Industrial applications of enzymes	(07L)
6	**Unit 6:- Lipids** 6.1 Introduction.	(03L)

	6.2. Fatty acids - Types and nomenclature (saturated and unsaturated). 6.3 Clinical significance (obesity, atherosclerosis, myocardial infarction). 6.4 Biological importance of lipids.	
7	**Unit 7:- Vitamins** 7.1 Fat soluble and water soluble 7.2 Dietary Sources and Deficiency disorders 7.3 Biological functions	(04L)
	Total Lectures	30

REFERENCES:

1.Principles of Biochemistry, 1993, Lehninger A. L. Nelson D. L. & Cox M. M. W. H. Freeman Company, USA.

2.Biochemistry, 1995 5th Edn. Zuby G. W, C. Brown Communications USA.

3.Harpers Biochemistry, 1996 26th Edn. p Murray R. K., Granner D. K., Mayes P. A. & Rodwell V. W. Prentice Hall international USA.

4.Outline of Biochemistry, 1995 5th Edn, Conn E. E., Stumph P. K. Bruening G & Doi R. H. John Wiley & Sons, USA.

5.Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N. Gajanan Book publishers and distributors Bangalore.

6. Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai.

7. Biochemistry, 1995 5th Edn., Stryer San Francisco, W. H. Freeman & Co.

8. Biochemistry, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York

9. David T. Plummer: An Introduction to Practical Biochemistry, IIIrd edition (1988)

Subject Code: - ZOO35102 Subject Name -: Entomology No. of credits: 02						
Year : III			Semester : V			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

CO1: The students will understand the basic concepts in Entomology and its scope.

CO2: The students will be able to Learn morphology and anatomy of Insects.

CO3: The students will Understand the concept of social organization in Insects.

Sr.No.	Name of the Topic	Lectures allotted
1	**Unit 1:- Fundamentals of Entomology:** 1.1 Definition and scope of Entomology. 1.2 General Classification of Insect. 1.3 General Characters of Insects.	(02L)
2	**Unit 2:- Insect Morphology** 2.1 Insect head, Head Orientations, Head articulations, Insect antennae and Mouth parts. 2.2 Insect Thorax, Insect Wing and modifications, Insect Leg and Modifications – a) Cursorial – Cockroach. b) Fossorial – Mole cricket. c) Saltorial – Grasshopper. d) Raptorial – Praying mantis,. e) Pollen basket – Honey bee.	(05L)

	2.3 Insect Abdomen, Genital and Pre – genital appendages of Cockroach.	
3	**Unit 3: l Insect Anatomy (Cockroach)** 3.1 Digestive System. 3.2 Circulatory System. 3.3 Nervous System. 3.4 Respiratory System. 3.5 Reproductive System.	(06L)
4	**Unit 4 :- Insect Ecology:** 4.1 Definition of Insect Ecology. 4.2 Abiotic Factors (Photoperiod, Temperature and Humidity) and Biotic Factors (Food, Foraging and Nesting). 4.3 Mimicry in insects with suitable examples.	(04L)
5	**Unit 5:- Insect Metamorphosis** 5.1 Definition, Types and examples of Metamorphosis. 5.2 Hormonal control of metamorphosis.	(03L)
6	**Unit 6:- Insects as social groups** 6.1 Definition & significance of Eusociality. 6.2 Intraspecific and Interspecific relationships among insects. 6.3 Social organization in Wasps and Termites.	(05L)
7	**Unit 7:- Economic Importance of Insects** 7.1 Insects as food. 7.2 Insects as Vectors. 7.3 Insects in Research 7.4 Insects in Medicines and Cosmetics.	(05L)

REFERENCES:

1. Lives of Social Insects, 1968, P. P. Larson, M. W. Larson, World Pub. Co.
2. Modern Entomology, 2nd edition - By D. B. Tembhare, Himalaya Publication House, Bombay.
3. Principles of Insect Morphology - By R. E. Snodgrass, Tata Mc-Graw Hill Bombay.

4. The Insect: Structure & Function - By R. F. Chapman, E. L. B. S., & E. U. P. London.
5. General Entomology, 2nd edition - By M. S. Mani Oxford & IBH Publishing Company, New Delhi.
6. A Text book of Entomology - By H. H. Ross, John Wiley and Sons, Ins. New York.
7. An Introduction to Entomology - By J. H. Comstock, Ithaca, New York.
8. General & Applied Entomology - By K. K. Nayar, T. N. Anathakrishnan & B.V. David, Tata McGraw-Hill, New Delhi.

Subject Code: - ZOO35103
Subject Name -: Environmental Resource Management
No. of credits: 02

Year : III			Semester : V			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**02**	**20**	**30**	**50**

Environmental Resource Management Course Outcomes:

CO1: Describe the branches and scope of Environmental biology, emphasizing its environmental importance.

CO2: Understand Ecosystem and its Interactions.

CO3: Understand Energy flow in the Ecosystem Environmental Pollution.

CO4: Students understand Natural Resources and Conservation and wildlife management and acquainted with Environmental Education.

Sr. No.	Name of the Topic	Lectures allotted
1	**Unit 1: Environmental Biology** 1.1 Introduction of Environmental Biology 1.2 Scope of Environmental Biology 1.3 Concept of Biosphere, lithosphere, Atmosphere Hydrosphere.	(02L)
2	**Unit 2: The Ecosystem** 2.1 Definition, abiotic and biotic components and their interrelationship. 2.2 Nutrient cycles in ecosystem. atmospheric cycles & edaphic nutrient cycles. 2.3 Energy flow in ecosystem and flow models. 2.4. Major Ecosystems Natural ecosystem: fresh water e.g. Pond water, Forest ecosystem, Artificial ecosystem: crop land. 2.5 Food chain in ecosystem and food web. 2.6 Ecological pyramids.	(06L)
3	**Unit 3: Environmental Pollution** 3.1 Definition and types of pollution. 3.2 Pollutants, types of pollutants. (metallic, gaseous, acids, alkalis, biocides) 3.3 Air pollution: Definition, sources of air pollutants, their effects.(biodegradable, non-biodegradable) 3.4 Air pollution and its relation with the following. 3.5 Acid rain Greenhouse effect Ozone layer. 3.6 Water pollution: definition, sources of water pollutants, their effects on ecosystem.	(05L)
4	**Unit 4: Environment and Development.** 4.1 Bioindicators and environmental monitoring. 4.2 Environmental challenges in India: land degradation, population explosion, urbanization and industrialization. 4.3 Efforts to meet the environmental challenges.	(05L)

5	**Unit 5: Natural Resources and Conservation** 5.1 Renewable and non-renewable resources. 5.2 Soil conservation 5.3 Forest conservation. 5.4 Energy sources: conventional and non-conventional.	(05L)
6	**Unit 6: Wildlife Management** 6.1 Definition, causes of wildlife depletion. 6.2 Importance of wildlife, management in India. 6.3 Endangered species, vulnerable species, rare species , threatened species 6.4 Wildlife conservation. 6.5 Use of technology in Wildlife conservation 6.6 Conservation strategy-Cheetah reintroduction, Project Tiger.	(05L)
7	**Unit 7: Environmental Education** 7.1 Goals and objectives. 7.2 Role of environmental organizations & agencies.	(02L)

REFERENCE:

1. Fundamentals of Ecology - M C Dash, Tata Mcgraw-Hill Publishing Co. Ltd.1998

2. Concepts of Ecology - Edward J. Kormondy, Prentice-Hall Of India Pvt. Ltd.1996

3. Ecology - Mohan P. Arora, Himalaya Publishing House, 2004

4. Environmental Biology-Biswarup Mukherjee, Tata Mcgraw-Hill Publishing Co.Ltd,1996

5. Fundamentals of Ecology-Eugene P. Odum, Natraj Publishers, 199.

6 Environmental Education - Nagarajan and Sivakumar. P, Ram Publishers, Chennai, (2002). 7. A text book of Environment - Agarwal. K. M. Sikdar. P. K. and Deb. S. C, Mac Miller India Ltd., Calcutta, (2002).

Subject Code: - ZOO35104 Subject Name -: Practicals in Biological Chemistry No. of credits: 02						
Year : III			Semester : V			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Practical per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

CO 1: To understand the basic concepts and significance of biochemistry.
CO2: To study the basic concepts pH and Buffers.
CO3: To know the structure and importance of proteins.
CO4: To evaluate the variations in enzyme activity and kinetics.

Sr. No.	Name of the Practical	Practical allotted
1	Preparation of Acid, Alkali & it's standardization	1P
2	Isolation of starch from potato and digestion of starch by salivary amylase	1P
3	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests.	1P
4	Principle, Working & Measurement of pH of any three samples.	1P
5	Preparation of buffer of desired pH and molarity	1P
6	Protein estimation by Bradford method.	1P
7	To study the principle and working of colorimeter and spectrophotometer.	1P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO35104 : Practicals in Biological chemistry (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES :

1. Principles of Biochemistry, 1993, Lehninger A. L. Nelson D. L. & Cox M. M. W. H. Freeman Company, USA.
2. Biochemistry, 1995 5th Edn. Zuby G. W, C. Brown Communications USA.
3. Harpers Biochemistry, 1996 26th Edn. p Murray R. K., Granner D. K., Mayes P. A. & Rodwell V.

   W. Prentice Hall international USA.
4. Outline of Biochemistry, 1995 5th Edn, Conn E. E., Stumph P. K. Bruening G & Doi R.

   H. John Wiley & Sons, USA.
5. Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N. Gajanan Book publishers and distributors Bangalore.

Subject Code: - ZOO35105

Subject Name -: Practicals in Environment Resource Management

No. of credits: 02

Year : III			**Semester : V**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Practical per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

CO1: To understand the abiotic and biotic factors of environment.

CO2: To study the various ecosystems.

CO3: To study and identify freshwater Zooplanktons

CO4: To study the water parameters of fresh-water ecosystems.

CO5: To study biodiversity indices.

Sr. No.	Name of the Practical	Practical allotted
1	Study of environmental pollutants	1P
2	Study of alkalinity from water sample.	1P
3	Study of hardness of water sample.	1P
4	Study of salinity of water sample.	1P
5	Study and identification of freshwater Zooplanktons.	1P
6	To study population dynamics of fresh-water ecosystem	1P
7	Study of biodiversity indices.	1P
8	Compulsory field visit to effluent/sewage treatment plant	2P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO35105 : Practicals in Environment Resource Management (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. Fundamentals of Ecology - M C Dash, Tata Mcgraw-Hill Publishing Co. Ltd.1998

2. Concepts of Ecology - Edward J. Kormondy, Prentice-Hall Of India Pvt. Ltd.1996

3. Ecology - Mohan P. Arora, Himalaya Publishing House, 2004

4. Environmental Biology-Biswarup Mukherjee, Tata Mcgraw-Hill Publishing Co.Ltd,1996

5. Fundamentals of Ecology-Eugene P. Odum, Natraj Publishers, 199.

Subject Code: - ZOO35106 Subject Name -: Bioinstrumentation and Bioinformatics No. of credits: 02						
Year : III			Semester : V			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Major Elective	**02**	**30**	**02**	**20**	**30**	**50**

Course outcomes:

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

CO1 : Understand the principle, significance and applications of biological techniques.

CO2: Apply the knowledge of different Separation and Microscopic techniques.

CO3: Analyse and comprehend the good laboratory practices and safety measures.

CO4 : Illustrate the database tools with their significance.

CO5 : Apply the knowledge of different bioinformatics web resources, tools and databases.

Sr. No.	Name of the Topic	Lectures allotted
1	**Unit 1: Introduction to Good Laboratory Practices** 1.1 Laboratory safety and etiquettes. 1.2 Hazardous and Toxic substances. 1.3 Risk groups and Biosafety Levels.	(02 L)
2	**Unit 2: Microscopy** 2.1 Construction, principle and applications of Bright and Dark Field Microscopy 2.2 Types of microscopes (Compound, Phase contrast and fluorescent microscope) and their uses.	(03 L)

3	**Unit 3: 3. pH** 3.1 Sorenson's pH scale. 3.2 pH meter – principle and applications.	(02 L)
4	**Unit 4: Colorimetry and Spectrophotometry** 4.1 Beer – Lambert's Law and its derivation. 4.2 Principle, working and Applications of colorimeter and spectrophotometer.	(02 L)
5	**Unit 5: Separation techniques** **5**.1 Centrifugation – principle, working and applications**,** Types of Centrifuges used in Biology. 5.2 Chromatography- principle, working and applications of Thin Layer, Column, Gas chromatography and HPLC. 5.3 Electrophoresis- Support media used in electrophoresis, Types- Native, Agarose and SDS- PAGE.	(06 L)
6	**Unit 6: Introduction to Bioinformatics** 6.1 Scope and Application of Bioinformatics. 6.2 Bioinformatics web resources (NCBI, EBI, OMIM, PubMed). 6.3 Different Search engines and computer programs useful in Biology.	(03 L)
7	**Unit 7: Biological databases and tools** 7.1 Primary sequence databases: Nucleic acid sequence databases (GenBank, EMBL- EBI) 7.2 Protein sequence databases (UniProtKB,) 7.3 Secondary sequence databases 7.4 Derived databases – PROSITE.	(05 L)
8	**Unit 8: Sequence alignment methods** 8.1 BLAST, FASTA. 8.2 Types of sequence alignment (Pairwise & Multiple sequence alignment). 8.3 Significance of sequence alignment.	(04 L)
9	**Unit 9: Predictive applications using DNA and protein sequences**	(03 L)

	1.1 Concept of phylogenetic tree. 1.2 Introduction to the Era of Omics- Proteomics, Pharmacogenomics and Metabolomics (Significance and Applications).	

REFERENCES:

1. Introduction of Medical Laboratory Technique,1998, 7th Edn., Baker F. J., Silverton R. E., Pallister C. J., Butterworth-Heinemann, UK.
2. Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
3. Cytological techniques: The Principles Underlying Routine Methods, 1963,Baker J. R., Methuen & Co., London.
5. Microscope and microscopic life, 1979, 2nd Edn., Peter Healey, Hamlyn, UK.
6. Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P. K. Bajpai, S. Chand and Co. Ltd., New Delhi.
7. Bioinformatics - Concepts, Skills, and Applications; S.C. Rastogi & others; CBS Publishing; 2003.

Subject Code: - ZOO35107

Subject Name -: Practicals in Bioinstrumentation and Bioinformatics

No. of credits: 02

Year : III **Semester : V**

Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Practicals per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Major Elective	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

CO1: To understand various evidences of evolution.

CO2: To study the various adaptations in animals.

CO3: To understand successive stages of evolution of man.

CO4: To study and understand zoogeographical distribution of animals in different zoogeographical realms.

Sr. No.	Name of the Practical	Practical allotted
1	To study the working and principle of different types of microscopes.	1P
2	To study the separation of dyes using Thin Layer chromatography.	1P
3	To study of blood and its constituents using Centrifuge.	1P
4	To measure the optical density of colored compounds using colorimeter.	1P
5	Isolation and Quantification of DNA using Nanodrop method.	1P
6	Study of bioinformatics and Biological databases	1P
7	Study of Bioinformatics tools and web resources.	1P
8	Retrieval of Nucleotide sequence from GenBank.	1P
9	Retrieval of Protein sequence from GenBank.	1P
10	Sequence Similarity Search using BLASTN.	1P
11	Sequence Similarity Search using BLASTP.	1P
12	To browse genomic resources for prokaryotic and eukaryotic genomes.	1P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO35107 : Practicals in Bioinstrumentation and Bioinformatics (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
2. Cytological techniques: The Principles Underlying Routine Methods, 1963,Baker J. R., Methuen & Co., London.
3. Microscope and microscopic life, 1979, 2nd Edn., Peter Healey, Hamlyn, UK.
4. Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P. K. Bajpai, S. Chand and Co. Ltd., New
5. Bioinformatics - Concepts, Skills, and Applications; S.C. Rastogi& others; CBS Publishing; 2003.
7. Introduction to Bioinformatics; 1st Edition; T K Attwood, D J parry- Smith; Pearson Education, 11th Reprint; 2005

Subject Code: ZOO35208 Subject Name -: Biodiversity conservation and sustainable development No. of credits: 02						
Year: III				Semester: V		
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Minor	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

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

CO1: To create and disseminate knowledge to the students about environmental problems at local, regional and global scale.

CO2: To introduce about ecosystems, biodiversity and to make aware for the need of conservation.

CO3: To sensitize students towards environmental concerns, issues, and impacts of human population.

CO4: To prepare students for successful career in environmental departments, research institutes, industries, consultancy, and NGOs, etc.

Sr. No	Name of the Topic	Lectures allotted
1.	**Unit 1**: **Biodiversity** 1.1 Definition and Types of Biodiversity (Genetic, Species and ecological).	(02L)
2.	**Unit 2**: **Levels of biological diversity** 2.1 Genetic, species and ecosystem diversity.	(04L)

	2.2 Biodiversity Hotspots.	
3.	**Unit 3**: **Biogeographic zones of India** (Trans-Himalayan Region, Himalayan Zone, Indian Desert Zone, Semi-arid Zone, Western ghats, Deccan Plateau, Gangetic plain, North East Region, Islands, Costal region)	(04L)
4.	**Unit 4**: **India as a mega-biodiversity nation** 4.1 The International Union for Conservation of Nature (IUCN) 4.2 Categories of wildlife (Endangered, Endemic, Extinct species of India and IUCN Red list)	(04L)
5.	**Unit 5**: **Threats to biodiversity** 5.1 Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. 5.2 Neothreats-Environmental contaminants, particulate matter, gases, industrialization.	(04L)
6.	**Unit 6**: **Conservation of biodiversity** 6.1 In-situ conservation of biodiversity. 6.2 Ex-situ conservation of biodiversity.	(04L)
7.	**Unit 7**: **Natural Resources and Sustainable Development** 7.1 Overview of natural resources: Definition of resource; 7.2 Classification of natural resources- Biotic and abiotic, Renewable and non-renewable.	(04L)
8.	**Unit 8: Sustainable development**	(04L)

	8.1 Sustainable Development Goals (SDGs) 8.2 Targets, indicators, challenges and strategies for SDGs	
	Total Lectures	30

REFERENCES:

1. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.

2. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.

3. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

4. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.

5. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)

6. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals

7. Down to Earth, Centre of Science and Environment ®.

Subject Code: ZOO35209 **Subject Name -: Practicals in Biodiversity conservation and sustainable development** **No. of credits: 02**	
Year : III	**Semester : V**
Teaching Scheme	**Evaluation Scheme**

Course Type	Credits	Number of Teaching hours	Practical per week	Internal Assessment	Semester End Exam	Total
Minor	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

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

CO1: To create and disseminate knowledge to the students about environmental problems at local, regional and global scale.

CO2: To introduce about ecosystems, biodiversity and to make aware for the need of conservation.

CO3: To sensitize students towards environmental concerns, issues, and impacts of human population.

CO4: To prepare students for successful career in environmental departments, research institutes, industries, consultancy, and NGOs, etc.

Sr. No.	Title of the Practical	No. of Practicals
1.	Study of soil fauna: collection, sampling, preservation and analysis.	2P
2.	Study of water quality and dissolved oxygen content in water samples of an ecosystem.	1P
3.	Collection, identification and preservation of various insect orders and arthropod groups (including study of permanent specimens).	1P
4.	Museum preservation techniques of selected vertebrates and invertebrates.	1P
5.	Using photographs / paintings / coloured drawings identify and study ecological role of characteristic animal species (major representative species only) of various Biomes.	2P
6.	Using photographs / paintings / coloured drawings identify and	2P

	study ecological role of characteristic plant species (predominant trees / shrubs only) of various biomes.	
7.	Study of animal architecture (photographs / diagram / abandoned specimen); Hive of honey bee, nest of paper wasp, nest of potter wasp, mount of termite, nests of weaver bird and tailor bird).	2P
8.	Sampling of plant and animal biodiversity of the College campus	2P
9.	Visit to ZSI Pune and other places.	1P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO35209 : Practicals in Biodiversity conservation and sustainable development (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. Standard Methods For The Examination Of Water And Waste Water (E.D. 17) by American Public Health Association & Others
2. Chemistry For Environmental Engineering (E.D. 3) by Sawyer Clairn& McCarthy Perry L
3. Laboratory Manual For The Examination Of Water, Waste Water & Soil by Rump H. H. &Krist H.
4. Brusseau, M.L., Pepper, I.L., and Gerba, C.P. (2019). Environmental and Pollution Science, 3rd Edition. Academic Press, USA. (pp. 1-520).
5. Divan, S. and Rosencranz, A. (2002). Environmental Law and Policy in India: Cases,

Material & Statutes, 2nd Edition. Oxford University Press, India. (pp. 1-837).

6. Gadgil, M., and Guha, R. (1993). This Fissured Land: An Ecological History of India. University of California Press, Berkeley, USA. (pp. 1-245).
7. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). Environment, 8th Edition. Wiley Publishing, USA. (pp. 1-472).

Subject Code: - ZOO35410

Subject Name -: Practical in Entomology

No. of credits: 02

Year : III			Semester : V			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Practical per week**	**Internal Assessment**	**Semester End Exam**	**Total**
VSEC	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

CO1: To understand the external characters of Cockroach.
CO2: To study the various digestive system of Cockroach.
CO3: To prepare temporary mounting of mouthparts, antennae, legs and wings of Cockroach.
CO4: To study the social organization in social insects.
CO5: Study of insect vectors.
CO6: Identification of gut parasites from the cockroach.

Sr. No.	Name of the Practical	Practical allotted
1	Study of external characters of any Insect- Cockroach.	1P
2	Study of Insect Head, its articulations and types of mouthparts and their modifications.	1P
3	Study of insect legs, wings and their modification.	1P

4	Study of Digestive system of any locally available insect pest.	1P
5	Temporary mountings of Mouthparts, Antennae, Legs and Wings of Cockroach.	1P
6	Study of Digestive system of Cockroach.	1P
7	Study of Reproductive System of Cockroach.	1P
8	Study of insect egg, larva, pupa and their types.	1P
9	Study of Insect vectors - Mosquito, House fly, Cockroaches, Bugs.	1P
10	Study of Social organization in Wasps and Termites.	1P
11	Compulsory field visit to wildlife sanctuary/National parks/to study the insect diversity.	1P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO35410 : Practicals in Entomology (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. Lives of Social Insects, 1968, P. P. Larson, M. W. Larson, World Pub. Co.
2. Modern Entomology, 2nd edition - By D. B. Tembhare, Himalaya Publication House, Bombay.
3. Principles of Insect Morphology - By R. E. Snodgrass, Tata Mc-Graw Hill Bombay.
4. The Insect: Structure & Function - By R. F. Chapman, E. L. B. S., & E. U. P. London.
5. Social Insects: Their Origin and Evolution, 2006, W. M. Wheeler, Discovery Publishing House, Delhi.

SEMESTER VI

Subject Code: - ZOO36101 Subject Name -: Molecular Biology No. of credits: 02						
Year : III			Semester : VI			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

CO1: Understand Nucleic acid types and structure.

CO2: Understand the Structure of DNA and RNA, DNA and RNA as genetic material.

CO3: Understand the Central Dogma of Molecular Biology.

CO4: Understand the concept of gene regulation, and application of DNA fingerprinting and PCR.

Sr. No.	Name of the Topic	Lectures allotted
1	**Unit 1: Nucleic Acids** 1.1 Structure of DNA and RNA 1.2 Types of DNA and RNA 1.3 DNA as genetic material - evidences (Griffith's, Avery et al., Hershey and Chase experiment	(06L)
2	**Unit 2: Central Dogma of Molecular Biology** 2.1 DNA Replication: Basic mechanism of replication in prokaryotes and eukaryotes. 2.2 Transcription -Basic mechanism of transcription in prokaryotes and eukaryotes. 2.3 Role of RNA polymerase enzyme in prokaryotes. 2.4 Inhibitors of Transcription	(12L)

	2.5 RNA modifications and processing (splicing - mRNA, modifications at 3'and 5' end). 2.6 Translation - Basic mechanism of Translation in prokaryotic and eukaryotic cells. 2.7 Genetic code, properties of genetic code.	
3	**Unit 3: Gene Regulation** 3.1 Inducible- Lac operon, Regulatory Gene, Promotor, Operator gene. 3.2 Repressible -Trp Operon	(04L)
4	**Unit 4: Recombinant DNA Technology** 4.1 Restriction enzymes and its types. 4.2 Types of Cloning vector. 4.3 Steps of Recombinant DNA technology.	(06L)
5	**Unit 5: Application of Molecular Biology** 5.1 Concept of PCR and RTPCR and its Mechanism. 5.2 DNA finger printing. 5.3 Molecular Markers and its Importance.	(02L)
	Total Lectures	30

REFERENCES:

1. Molecular biology of cell, 3rd and 4th edition, Albert's B. D. Lewis J. Raff M. Roberts K. and Watson.
2. Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.
3. Molecular biology of the Gene, 1993, Watson J. Hopkins, Roberts Steitz & Weiner, Benjamin Cummings.
4. Text Book of Molecular Biology, 1994, K. Sivrama Sastry G. Padmanabhan and C. Subramanyam : MacMillan, India.
5. Cell and Molecular biology, 1996, G. Karp, John Willey & Sons, U.S.A. CBCS: 2021-

2022.

6. Principles of Genetics, 1997, P. D. Snustad, M. L. Smmons, J. B. & Jenkins, John Willey & Sons, U.S.A.

7. Cell and Molecular biology, De Robertis and De Robertis, 8th & 9th Edition, Saunders Publications.

Subject Code: - ZOO36102 Subject Name -: Parasitology No. of credits: 02						
Year : III			**Semester : VI**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

CO1: To learn about the basics and scope of parasitology.

CO2: To know the types of host and parasite with examples.

CO3: To learn about host -parasite relationships and their effects on host body.

CO4: To understand about the morphology, life cycle, pathogenicity and treatment of common parasites (Protists, Parasitic worms and Arthropods).

CO5: To understand causative agents, modes of transmission of zoonotic diseases.

Sr. No.	Name of the Topic	Lectures allotted
1	**Unit 1: Introduction, Scope and Branches of Parasitology.** 1.1. Definition: host, parasite, vector, commensalisms, mutualism and parasitism. 1.2. Branches of parasitology. 1.3 Scope of parasitology.	(02L)
2	**Unit 2: Types of Parasites and Hosts** 2.1 Ectoparasites.	(03L)

	2.2 Endoparasites and its subtypes. 2.3 Types of hosts - Intermediate, definitive, paratenic and reservoir.	
3	**Unit 3: Host - Parasite relationship** 3.1 Host specificity. 3.2 Types of host specificity: structural specificity, physiological specificity and ecological specificity. 3.3 Effects of parasite on the host.	(03L)
4	**Unit 4: Study of Parasitic Protists** 4.1 *Entamoeba histolytica* - Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 4.2 *Plasmodium vivax* - Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.	(07L)
5	**Unit 5: Study of Parasitic worms:** 5.1 *Ascaris lumbricoides* - Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 5.2 *Taenia solium* (Tapeworm) - Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.	(06L)
6	**Unit 6: Study of Parasitic Arthropoda** Morphology, pathogenicity and control measures of – 6.1 Soft and Hard tick. 6.2 Head louse. 6.3 Rat flea. 6.4 Bed bug.	(04L)
7	**Unit 7: Zoonotic diseases.** 7.1 Definition and types of zoonotic diseases. 7.3 Causative agents and modes of transmission.	(02L)
8	**Unit 8: Tools and techniques used in the diagnosis of parasites** 8.1 Microscopic and macroscopic examination. 8.2 Indirect method of examination-antigen and antibody based.	(03L)
	Total Lectures	30

REFERENCES:

1. Parasitology: K. D. Chatterjee.

2. Parasites: ecology, diseases, and management (2013).

3. Parasitic Helminths: Targets, Screens, Drugs, and Vaccines, 201.

4. Parasitism: The Diversity and Ecology of Animal Parasites (2014) Tim Goater, Timothy M. Goater, Cameron P. and Esch, Gerald W. Cambridge University Press.

5. Principles of Veterinary Parasitology (2016), 1st Edn, Dennis E. Jacobs, Mark Fox, Lynda M. Gibbons, Carols Hermosilla, John Wiley & Sons.

6. Veterinary Parasitology (2013), Hany M. Elsheikha, Jon S. Patterson, CRC Press Taylor & Francis Group

7. Textbook of medical parasitology – C. K. Jayaram Panikar.

8. Textbook of medical parasitology – Arora & Arora.

Subject Code: ZOO36103

Subject Name -: Developmental Biology

No. of credits: 02

Year : III			Semester : VI			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

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

CO1: Define basic terms, concepts and theories of developmental biology.

CO2: Explain the process of gamete formation and fertilization.

CO3: Explain the cleavage, blastulation and gastrulation events in fertilized egg.

CO4: Explain the various events in chick embryology.

Sr. No.	Name of the Topic	Lectures allotted
1.	**Unit 1: - Fundamentals of Developmental Biology:** 1.1 Definition and scope. 1.2 Concepts in Developmental Biology: Growth, Differentiation, Dedifferentiation, Cell determination, Cell Specification, Cell communication, Morphogenesis, Induction, Competence and Regeneration.	(03L)
2.	**Unit 2: - Theories of Developmental Biology** 2.1 Preformation. 2.2 Pangenesis. 2.3 Epigenesis. 2.4 Axial gradient. 2.5 Germplasm.	(04L)
3.	**Unit 3: - Gametogenesis** 3.1 Structure of T.S. of Testis; Spermatogenesis & Structure of sperm with respect to human. 3.2 Structure of T.S. of Ovary; Oogenesis & Structure of ovum with respect to human. 3.3 Types of eggs	(05L)
4.	**Unit 4: - Fertilization:** 4.1 Concept and types. 4.2 Chemotaxis. 4.3 Sperm penetration: Acrosome reaction, Capacitation & Decapacitation.	(05L)

	4.4 Activation of ovum: Fertilization cone. 4.5 Prevention of polyspermy: Fast block & Slow block. 4.6 Significance of fertilization.	
5.	**Unit 5: - Cleavage and Blastula** 5.1 Definition and concept. 5.2 Planes and symmetry of cleavage. 5.3 Types of cleavage. 5.4 Significance of cleavage. 5.5 Definition and types of Blastula.	(04L)
6.	**Unit 6: - Gastrulation** 6.1 Definition and Concept. 6.2 Basic cell movements in gastrulation: Epiboly, Emboly, Invagination & Involution with reference to frog. Concept of Organizer: Primary, Secondary and Tertiary.	(05L)
7.	**Unit 7: - Chick Embryology** 7.1 Structure of Hen's egg. 7.2 Fertilization and cleavage in Chick. 7.3 Blastulation and Gastrulation in chick (Formation of primitive endoderm, Primitive streak development, Head process and regression of Primitive streak).	(04L)
	Total Lectures	**30**

REFERENCES:

1. An Introduction to Embryology (2012), 5th Edition., Balinsky B. L., Fabian B. C. Brooks

Cole Pub. Co., USA

2. Developmental Biology (2013), 10th Edn. Gilbert S. F., Sinauer Associates Inc.

3. Developmental Biology: Patterns, Principle and Problems (1982), Saunders J. W., Prentice Hall Coll Div.

4. Principles of Development (2007), 3rd edition, Lewis Wolpert, Oxford University Press Publisher.

Subject Code: - ZOO36104 **Subject Name -: Practical in Molecular Biology** **No. of credits: 02**						
Year : III			**Semester : VI**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Practical per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

CO1: Students will be able to learn laboratory safety techniques and sterilization methods.

CO2: The students will be able to prepare DNA paper model and understand its characteristics.

CO3: The students will able to isolate prokaryotic and eukaryotic DNA.

CO4: The students will be able to understand the principle and working of spectrophotometer and PCR.

Sr. No.	**Name of the Practical**	**Practicals allotted**
	Practicals in Molecular Biology	1P
1	Lab safety techniques and sterilization.	1P
2	Staining of DNA and RNA by methyl green- pyronin.	1P
3	Estimation of DNA by diphenylamine method	1P
4	Isolation of DNA from bacteria.	1P

5	Absorption spectra of DNA isolated from bacteria.	1P
6	Isolation of eukaryotic DNA from chicken liver.	1P
7	Principle and Application of Spectrophotometer.	1P
8	Principle and working of thermal cycler.	1P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO36104 : Practical's in Molecular Biology (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. Molecular biology of cell, 3rd and 4th edition, Albert's B. D. Lewis J. Raff M. Roberts K. and Watson.
2. Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.
3. Molecular biology of the Gene, 1993, Watson J. Hopkins, Roberts Steitz & Weiner, Benjamin Cummings.
4. Text Book of Molecular Biology, 1994, K. Sivrama Sastry G. Padmanabhan and C. Subramanyam : MacMillan, India.
5. Cell and Molecular biology, 1996, G. Karp, John Willey & Sons, U.S.A. CBCS: 2021-2022.
6. Principles of Genetics, 1997, P. D. Snustad, M. L. Smmons, J. B. & Jenkins, John Willey & Sons, U.S.A.
7. Cell and Molecular biology, De Robertis and De Robertis, 8th & 9th Edition, Saunders Publications.

Subject Code: - ZOO36105 Subject Name -: Practical in Parasitology & Developmental Biology No. of credits: 02						
Year : III			Semester : VI			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**practicals per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Mandatory Major	**02**	**30**	**01**	**20**	**30**	**50**

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Course Outcomes:

CO1: Students will be able to explain various pathologies in humans.

CO2: The students will be able to understand the life cycle, pathogenicity, diagnosis and treatment of various parasites through permanent slides or microphotographs.

CO3: The students will able to understand the role of parasites as vector.

CO4: The students will be able to identify gut parasites in cockroach.

CO5: The students will be able to understand the ultrastructure of sperm and ovum of humans.

CO6: The students will be able to understand the cleavage, blastula and gastrula in Amphioxus, Frog and Hen.

CO7: The students will be able to understand the whole mount developmental stages of chick embryo.

CO8: The students will be able to understand to prepare temporary mounting of chick embryo.

Sr. No.	Name of the Practical	Practicals allotted
	Practical in Parasitology	
1	Study of parasitic association with their example - a) Commensalism. b) Parasitism	1P
2	To study the life cycle, pathogenecity, diagnosis and treatment of *Entamoeba histolytica* and *Plasmodium vivax* through permanent slides or microphotographs	1P

3	To study the life cycle, pathogenecity, diagnosis and treatment of *Ascaris lumbricoides* and *Taenia solium* through specimen, permanent slides or microphotographs	1P
4	Study of following parasites with its role as vector – soft tick and hard tick, Mite (*Sarcoptes scabiei*), *Pediculus humanus, Xenopsylla cheopis* and *Cimex lectularius* through permanent slides or photographs	1P
5	Study of parasites from the gut of cockroach	1P
	Practical in Developmental Biology	1P
1	Study of ultrastructure of sperm and Ovum of mammal.	1P
2	Study of different types of eggs with the help of slide/Photograph/Chart/Model (Insect, Amphioxus, Frog and Hen).	1P
3	Study of cleavage and its types with the help of slide/Photograph/Chart/Model	1P
4	Study of blastula and gastrulae (Amphioxus, Frog and Hen).	1P
5	Study of whole mounts of developmental stages of chick through permanent slides: 18 hrs upto 72, and 96 hours of incubation.	1P
6	Temporary mounting of chick embryos	1P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO36105 : practical's in Parasitology & Developmental Biology (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. 1. Parasitology: K. D. Chatterjee.

2. Parasites: ecology, diseases, and management (2013).

3. Parasitic Helminths: Targets, Screens, Drugs, and Vaccines, 201.

4. Parasitism: The Diversity and Ecology of Animal Parasites (2014) Tim Goater, Timothy M. Goater, Cameron P. and Esch, Gerald W. Cambridge University Press.

5. Principles of Veterinary Parasitology (2016), 1st Edn, Dennis E. Jacobs, Mark Fox, Lynda M. Gibbons, Carols Hermosilla, John Wiley & Sons.

6. Veterinary Parasitology (2013), Hany M. Elsheikha, Jon S. Patterson, CRC Press Taylor & Francis Group

7. An Introduction to Embryology (2012), 5th Edition., Balinsky B. L., Fabian B. C. Brooks Cole Pub. Co., USA.

8. Developmental Biology (2013), 10th Edn. Gilbert S. F., Sinauer Associates Inc.

9. Developmental Biology: Patterns, Principle and Problems (1982), Saunders J. W., Prentice Hall Coll Div.

10. Principles of Development (2007), 3rd edition, Lewis Wolpert, Oxford University Press Publisher.

Subject Code: - ZOO36106

Subject Name -: Medical & Forensic Zoology

No. of credits: 02

Year : III			**Semester : V**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Major Elective	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

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

CO1: To understand the basics of Medical and Forensic Zoology.

CO2: To know the scientific methods in crime detection.

CO3: To evaluate the advancements in the field of Medical and Forensic Zoology.

CO4: To analyze the fundamental principles and functions of forensic science and its

significance to human society.

Sr. No.	Name of the Topic	Lectures allotted
1	**Unit 1:- Introduction to Medical and Forensic Zoology and its importance:** 1.1 Definition, significance and scope. 1.2 Basic Principles of Forensic Science with Examples. 1.3 Different branches of Forensic Science. 1.4 Forensic Laboratories in India.	(04L)
2	**Unit 2 :- Medico-legal Autopsy:** 2.1 Death and its Causes- External examination of deceased body – Internal Examination - Determination of time since death and cause of death. 2.2 Injuries – Classification - Medico-legal aspects of injuries. 2.3 Post-mortem changes - collection of post-mortem samples and Preservation.	(05L)
3	**Unit 3: Diseases and their control** **3.1 Infectious diseases:** Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Tuberculosis and Hepatiti **3.2 Non infectious Diseases:** Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Diabetes (Type I and II), Hypertension, Hypotension, Obesity, Atherosclerosis, Myocardial Infraction.	(04L)
4	**Unit 4 :- Forensic Medicine** 4.1 Introduction to Forensic Medicine: Definitions of Forensic Medicine. 4.2 Medical Jurisprudence. 4.3 Medical evidence documentations.	(04L)

5	**Unit 5 :- Forensic analysis** 5.1 Examination of biological materials: Examination of Hair, Fibers, Diatoms, plants materials, human tissues. 5.2 Examination of Body Fluids: Blood, Semen and Saliva. 5.3 DNA Fingerprinting Technique and Examination of Biological Traces: Liquid blood, blood stains, & swabs, semen, Seminal stains, tissues, Bones, Hairs, Teeth, Saliva, Skeletal remains.	(05L)
6	**Unit 6:- Insects of forensic importance** 6.1 Forensic Importance of Insect 6.2 Insects of forensic importance - indicators of time of death stages of insect development & comparative decomposition of human body - colonization – 6.3 Evidence collection of insects – Territorial & Aquatic Insects.	(03L)
7	**Unit 7: Toxicological Investigations** 7.1 Poisons – Definition 7.2 Forms of Poison – Physical, Chemical & Mechanical state. 7.3 Introduction with examples of – Neurotoxic Poisons – Cerebral & Spinal, Cardiovascular Poisons, Asphyxiants.	(05L)
	Total Lectures	30

REFRENCES:

1. Godkar P. B and Godkar D. P, Textbook of Medical Laboratory Technology, II Edition, Bhalani Publications
2. Textbook of Microbiology: R. Ananthanarayan, C. K. Jayaram Panikar, University Press.
3. A textbook of Microbiology: P. Chakraborty
4. Text book of pathology: Robbins & Cotran, Vol. 1 & 2, Tenth Edition, Elsevier Publication.

5. Pathologic basis of disease: M. K. Singh & Vinay Kumar, Vol. 1 & 2, 10th edition, Elsevier.

6. Text book of General pathology: Bhende & Deodhare Part I & II.

7. Pathologic basis of Disease: Robbins & Cotran, Vol. 1 & 2, 10th edition, Elsevier publications.

8. Essentials of medical pharmacology: K. D. Tripathi, 8th edition, Jaypee brother's publishers.

9. Review of pharmacology: K. D. Tripathi, Jaypee brothers' publishers.

Subject Code: - ZOO36107

Subject Name -: Practical in Medical and Forensic Zoology

No. of credits: 02

Year : III			**Semester : VI**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**practicals per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Major Elective	**02**	**30**	**01**	**20**	**30**	**50**

Course Outcomes:

CO1: Students will be able to explain various pathologies in humans.

CO2: The students will be able to perform urine analysis.

CO3: The students will be able to determine urea/uric acid/creatinine and calcium in human blood.

CO4: The students will be able to understand morphology, scale pattern of human hair.

CO5: The students will able to understand various types of fingerprints.

CO6: The students will be able to identify blood stains and determine blood group from fresh blood and blood stains.

CO7: The students will be able to understand modern tools, techniques and skills in forensic investigations.

Sr. No.	Name of the Practical	practical's allotted
1	To carry out routine analysis of given urine sample i. Physical Properties: Volume, Colour, odour, pH, Turbidity, Specific gravity. ii. Chemical Properties: Sugars, Protein, Bile salts & bile pigments, Ketone bodies, Blood. (C	2P
2	Determination of serum urea/uric aci	1P
3	Determination of serum creatinine.	1P
4	Determination of serum Calcium.	1P
5	To examine human hair for cortex and medulla.	1P
6	To prepare slides of scale pattern of human hair.	1P
7	To examine hair morphology and determine the species to which the hair belongs.	1P
8	To Identify and differentiate various types of Finger prints.	1P
9	To carry out ten digit classification of fingerprints.	1P
10	To prepare a case report on forensic entomology with respect to insect's succession and its relationship to determine time since death.	1P
11	To Visit a Forensic Laboratory and submission of the report.	2P

Note: It is mandatory for the students to complete a minimum of two courses from the given links and earn the certificate relevant to the Practical courses:

ZOO36107 : practical's in Medical and Forensic Zoology (2C) (P)

https://swayam.gov.in/

https://nptel.ac.in/

https:// coursera.org/

REFERENCES:

1. W. G. Eckert and S. H. James, Interpretation of Bloodstain Evidence at Crime Scenes, CRC Press, Boca Raton (1989).

2. A textbook of Clinical pharmacology: Roger H. J., Spector R. G., Trounce J. R., Hodder & Stoughton publishers.

3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

4. J.E. Cowger, Friction Ridge Skin, CRC Press, Boca Raton (1983)

5. D.A. Ashbaugh, Quantitative-Qualitative Friction Ridge Analysis, CRC Press, Boca Raton (2000).

6. C. Champod, C. Lennard, P. Margot an M. Stoilovic, Fingerprints and other Ridge Skin Impressions, CRC Press, Boca Raton (2004).

7. Lee and Gaensleen's, Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013).

Subject Code: - ZOO36208
Subject Name -: Museology and Taxidermy of Invertebrates and Vertebrates
No. of credits: 02

Year : III			Semester : VI			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Lectures per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Minor	**02**	**30**	**02**	**20**	**30**	**50**

Course Outcomes:

CO1: Understand the importance of Environment.

CO2: Learn the impact of Pollution on Human health, natural resources.

CO3: Understand Environmental Protection acts and concepts sustainable development.

CO4: Understand types of Environmental Impact Assessment (EIA) and stakeholders in EIA Process.

Sr. No.	Name of the Topic	No of Lectures allotted
1	**Unit 1: Establishment of an Animal Museum** 1.1 Concept, Development and Types of Museums. 1.2 Definition, History, Scope and Significance of Museum. 1.3 Characteristic features of Ideal Museum.	(03L)
2	**Unit 2: Collection and Preservation Techniques for Invertebrate Animals** 2.1 Protozoans, Sponges, Coelenterates, Worms. 2.2 Annelids, Arthropods, Molluscans and Echinoderms.	(03L)
3	**Unit 3: Collection and Preservation Techniques for Vertebrate Animals** 3.1 Amphibians, Reptiles, Aves and Mammals.	(03L)
4	**Unit 4: Collection, Preservation and Embalming** 4.1 Collection and Preservation of Insects: Collecting Net, Sieve, Aspirator, Traps, Berlese Funnel, Killing Bottles. 4.2 Relaxing, Pinning, Spreading, Insect Box.	(04L)
5	**Unit 5: Collection and Preservation of Fishes** 5.1 Collection Methods: Fishing without any gear and only by hands. 5.2 Line fish (Angling), By fish screen, Fish trap. 5.3 Dipnet or Lift net, Cast net, Purse net , Gill net, Drag net. 5.4. Preservation Techniques: Cleaning, Gutting, Drying, Refrigeration, Deep freezing, Chemical Preservation. 5.5. Embalming. 5.6. Injecting.	(04L)

6	**Unit 6: Taxidermy** 6.1 Definition, History, Scope and Significance of Taxidermy. 6.2 Protection and Storage of Animal before Taxidermy. 6.3 Types and Process of Taxidermy. 6.4 Anthropomorphic Taxidermy. 6.5 Conservation and Restoration of Taxidermy. 6.6 Taxidermy of Birds/Mammals.	(06L)
7	**Unit 7: Preparation of Skeleton and Fixatives, Stains and Reagents** 7.1 Preparation of Skeleton. 7.2 Steps: Skinning, Removal of soft organs, Removal of muscles, Disarticulation, Cleaning, Bleaching, Curing, Polishing and Preservation. 7.3 Maceration: A bone preparation technique. 7.4 Conservation and Restoration of Bone, Horn and Antler objects. 7.5 Labelling: Labelling and Marking kit. 7.6 Cataloging: Purpose of Cataloging. 7.7 Display: Arrangement of specimens and slides. 7.8 Fixatives, Stains and Reagents: Alizarin Skeletal Staining.	(07)
	Total lectures	30

REFERENCES:

1. Alexis Turner: "Taxidermy": Thames and Hudson.
2. Dalela R.C. & Sharma R.S. "Animal Taxonomy & Museology" JP Nath & Company Meerut Nadine H. Roberts : "A Complete Handbook of Taxidermy": Tab books.
3. Roger J. Lincoth & J Gordon Sheals, "Invertebrate Animals Collection & Preservation"; Cambridge university Press.
4. Anderson Rudolph "Methods of collecting & Preserving vertebrate Animals"; Read Books.
5. Azhagu Madhavan; "Collection & Preservation of Insects;" Notion Press.
6. Swarup N., Arora S. and Pathak S.C, "laboratory techniques in Modern Biology" Kalyani Publication New Delhi.

Subject Code: - ZOO36209 Subject Name -: Practical in Museology and Taxidermy of Invertebrates and Vertebrates No. of credits: 02						
Year : III			Semester : VI			
Teaching Scheme				Evaluation Scheme		
Course Type	**Credits**	**Number of Teaching hours**	**Practicals per week**	**Internal Assessment**	**Semester End Exam**	**Total**
Minor	**02**	**30**	**01**	**20**	**30**	**50**

Sr. No.	Name of the Practical	practical's allotted
1	Collection, Preservation, Curation and Identification of animals.	2P
2	Preparation and Identification of Nets and Gears.	1P
3	Identification and Labelling of Collected animals (locally available)	1P
4	Preparation of permanent slide - Locally available small organisms (Invertebrates).	1P
5	Preparation of basic and acidic fixatives, stains and reagents.	2P
6	Observation of the procedure of Taxidermy through YouTube /videography.	2P
7	Observation of Bird Skeleton / Mammal Skeleton Preparation through YouTube/videography.	1P
8	Alizarin Skeletal Staining.	2P
9	Preparation of Insect Box with Preserved Insects, 5 Permanent Slides and 5 Preserved.	2P

	Specimens.	
10	Physical/Virtual visit to Animal Museum.	1P

REFERENCES:

1. Alexis Turner: "Taxidermy": Thames and Hudson.

2. Dalela R.C. & Sharma R.S. "Animal Taxonomy & Museology" JP Nath & Company Meerut Nadine H. Roberts : "A Complete Handbook of Taxidermy": Tab books.

3. Roger J. Lincoth & J Gordon Sheals, "Invertebrate Animals Collection & Preservation"; Cambridge university Press.

4. Anderson Rudolph "Methods of collecting & Preserving vertebrate Animals"; Read Books.

5. Azhagu Madhavan; "Collection & Preservation of Insects;" Notion Press.

6. Swarup N., Arora S. and Pathak S.C, "laboratory techniques in Modern Biology" Kalyani Publication New Delhi.

ZOO36610 On Job Training OJT (4C)

Subject Code: ZOO36610 Subject Name -: On Job Training (4C) No. of credits: 04						
Year : III			**Semester : VI**			
Teaching Scheme				**Evaluation Scheme**		
Course Type	**Credits**	**Number of Teaching hours**	**Practicals per week**	**Internal Assessment**	**Semester End Exam**	**Total**
OJT	**04**	**60**	**02**	**40**	**60**	**100**

Chairman, BOS **Principal**