Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune - 411 016

(Autonomous)

Syllabus for

T. Y. B.Sc (Zoology)

Introduction:

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.

degree shall be titled as Bachelor of Science in Zoology under the Faculty of Science and Technology. First Year B.Sc Zoology Based on Credit System is implemented w.e.f. the academic year 2022-2023 , Second Year B.Sc Zoology is implemented w.e.f. 2023-2024 ,Third Year B.Sc Zoology will be w.e.f. 2024-2025.

Programme Objectives:

B.Sc. Zoology Graduate's will be able to:

Po1: To create awareness amongst students for the basic and applied areas of Zoology

Po2: This course focus on conceptual grounding of computer usage as well as its practical Business Application.

Po3: To orient students about the importance of abiotic and biotic factors of environment and their conservation

Po4: To provide an insight to the aspects of animal diversity

Po5: To inculcate good laboratory practices in students and to train them about proper handling of lab instruments.

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Research Project
8. Group Discussion
9. Open Book Test
10. Written Test
11. PPT presentation
12. Industrial Visit
13. Viva

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Surveys
5. Power Point Presentations
6. Visit to Industries
7. Research Papers & Projects
8. E-content

Eligibility:

Students who have completed two years of leaning Zoology at F.Y. and S.Y.B.Sc level

Subject List

T.Y.B.Sc Zoology (Semester V)

Course Type	Sr. No.	Course(Subject) Title	Course (Subject) code	Credits	Weightage for Internal Marks	Weightage For External Marks	Weightage for practical	Total Marks
DSEC	**1**	Applied Entomology	24-ZO -351	**2**	**15**	**35**		**50**
DSEC	**2**	Histology and Histopathology	**24-**ZO-352	**2**	**15**	**35**		**50**
DSEC	**3**	Biological Chemistry	24 -ZO -353	**2**	**15**	**35**		**50**
DSEC	**4**	Genetics	**24 –**ZO -354	**2**	**15**	**35**		**50**
DSEC	**5**	Developmental Biology	**24-**ZO -355	**2**	**15**	**35**		**50**
DSEC	**6**	Medical Parasitology	24 –ZO-356	**2**	**15**	**35**		**50**
DSEC	**7**	Zoology Practical – I	**24-**ZO-357	**2**	**15**	**35**	**50**	
DSEC	**8**	Zoology Practical – II	**24-**ZO-358	**2**	**15**	**35**	**50**	
DSEC	**9**	Zoology Practical – III	**24-**ZO-359	**2**	**15**	**35**	**50**	
SEC	**10**	Fishery Management	**24-**ZO-359	**2**	**15**	**35**		**50**
SEC	**11**	Poultry Management	**24-**ZO-3511	**2**	**15**	**35**		**50**
Total				**22**				**550**

T.Y.B.Sc Zoology (Semester VI)

Course Type	Sr. No.	Course(Subject) Title	Course (Subject) code	Credits	Weightage for Internal Marks	Weightage For External Marks	Weightage for practical	Total Marks
DSEC	**1**	Forensic Zoology	**24-**ZO-361	**2**	**15**	**35**		**50**
DSEC	**2**	Animal Physiology	**24-**ZO-362	**2**	**15**	**35**		**50**
DSEC	**3**	Molecular Biology	**24-**ZO-363	**2**	**15**	**35**		**50**
DSEC	**4**	Pest Management	**24-**ZO-364	**2**	**15**	**35**		**50**
DSEC	**5**	Tools and techniques in Biology	**24-**ZO-365	**2**	**15**	**35**		**50**
DSEC	**6**	Evolutionary Biology	**24-**ZO-366	**2**	**15**	**35**		**50**
DSEC	**7**	Zoology Practical – I	**24-**ZO-367	**2**	**15**	**35**	**50**	
DSEC	**8**	Zoology Practical – II	**24-**ZO-368	**2**	**15**	**35**	**50**	
DSEC	**9**	Zoology Practical – III	**24-**ZO-369	**2**	**15**	**35**	**50**	
SEC	**10**	Biodiversity Assessment	**24-**ZO-3610	**2**	**15**	**35**		**50**
SEC	**11**	Project/Internship/ Hands on Training or Workshop	**24-**ZO-3611	**2**	**15**	**35**		**50**
Total				**22**				**550**

Credit Allocation: - CC-Core Course, EC-Elective Course, PR-Practical, PJ-Project, AECC-Ability Enhancement Compulsory Courses, SEC-Skill Enhancement Courses.

Total - 132 Credits for Three years Programme.

T.Y.B.Sc Zoology (Semester -V)
Course Code: Applied Entomology
Subject Name: **Applied Entomology**
Total lectures: 30 lectures **Total Credits: 02**

Prerequisites: -

- Student should know basics of entomology.

Course Objectives:

- To understand the fundamentals of Entomology.
- To understand various classes of insects.
- Recognizing the importance of insects.

Course Outcomes:-
At the end of this course, Students will -

1. Understand basic concepts in Entomology and its scope.

2. Learn morphology and anatomy of Insects.

3. Understand the concept of social organization in Insects.

4. Gain knowledge of the development process of Insects.

Unit	Topic	No of lectures
1	**Chapter 1:- Fundamentals of Entomology:** 1.1 Definition and scope of Entomology. 1.2 General Classification of Insects. 1.3 General Characters of Insects.	02
2	**Chapter 2 :- Insect Morphology** 2.1 Insect Integument and its derivatives. 2.2 Insect Head, Head Orientations, Head articulations, Insect antennae and Mouth parts. 2.3 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. 2.4 Insect Abdomen, Genital and Pre – genital appendages of Grasshopper.	07
3	**Chapter 3 :- Insect Anatomy (Grasshopper)** 3.1 Digestive System. 3.2 Circulatory System. 3.3 Nervous System. 3.4 Respiratory System. 3.5 Reproductive System.	04

4	**Chapter 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.	04
5	**Chapter 5:- Insect Metamorphosis** 5.1 Definition. 5.2 Types and examples of Metamorphosis.	03
6	**Chapter 6:- Insects as social groups** 6.1 Definition & significance of Eusociality, Intraspecific and Interspecific relationships among insects. 6.2 Social organization in Wasps and Termites.	06
7	**Chapter 7:- Economic Importance of Insects** 7.1 Insects in Research. 7.2 Insects in Medicines and Cosmetics. 7.3 Insects as Vectors. 7.4 Insects as food.	04
	Total Hours	30

References

1. Social Insects: Their Origin and Evolution, 2006, W. M. Wheeler, Discovery

Publishing House, Delhi.

2. Lives of Social Insects, 1968, P. P. Larson, M. W. Larson, World Pub. Co.

3. Modern Entomology, 2nd edition - By D. B. Tembhare, Himalaya Publication House, Bombay.

4. Principles of Insect Morphology - By R. E. Snodgrass, Tata Mc-Graw Hill Bombay.

5. The Insect: Structure & Function - By R. F. Chapman, E. L. B. S., & E. U. P. London.

6. General Entomology, 2nd edition - By M. S. Mani Oxford & IBH Publishing Company, New Delhi.

7. A Text book of Entomology - By H. H. Ross, John Wiley and Sons, Ins. New York.

8. An Introduction to Entomology - By J. H. Comstock, Ithaca, New York.

9. General & Applied Entomology - By K. K. Nayar, T. N. Anathakrishnan & B.V. David, Tata McGraw-Hill, New Delhi.

Subject Code-24-ZO-352

Subject Name: Histology and Histopathology

Total Contact Hours: 30 **Total Credits: 2**

Pre-Requisite:

- Students shall have the Basic Knowledge of Histology

Course Objectives:

1. To understand the fundamentals of histology
2. To understand and differentiate normal and abnormal tissues.

Course Outcomes:-

1. To understand, classify and identify the different types of tissue.
2. To know the complexity of various tissues in an organ.
3. To learn structure & functions of various tissues.
4. Knowledge of the various diseases related to organs.

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction:** 1.1 Definition and Scope of Histology. 1.2 Importance of Histology. 1.3 Overview of Microscopic Anatomy: Cells, Tissues & Organs.	02
2	**Chapter 2 :- Definitions and Review of Types of Tissues:** 2.1 Epithelial tissue. 2.2 Connective tissue. 2.3 Nervous tissue. 2.4 Muscular tissue.	03
3	**Chapter 3 :- Histological study of following mammalian organs** 3.1 Skin (V. S.). 3.2 Tooth (V. S.). 3.3 Tongue (C. S.) with reference to mucosa papillae and taste buds.	04

4	**Chapter 4 :- Histological study of Alimentary canal and Liver:** 4.1 Oesophagus (T. S.). 4.2 Stomach (T. S.). 4.3 Duodenum (T. S.). 4.4 Rectum (T. S.). 4.5 Liver (C. S.).	06
5	**Chapter 5:- Histological study of Respiratory organs** 5.1 Trachea (T. S.). 5.2 Lung (C. S.)..	02
6	**Chapter 6:- Histological study of Excretory organs** 6.1 Kidney (L. S.). 6.2 Juxtaglomerular complex.	03
7	**Chapter 7:- Histological study of Reproductive organs** 7.1 Testis (T. S.) with reference to Seminiferous Tubules and Cells of Leydig. 7.2 Ovary (C. S.).	04
8	**Chapter 8:- Histology of Endocrine glands** 8.1 Pituitary gland. 8.2 Thyroid gland. 8.3 Adrenal gland. 8.4 Pancreas (C. S.) including both exocrine and endocrine components. 8.5 L.S. of Mammary gland(exocrine gland)	06
	Total Hours	30

Reference Books: -

1. A Text Book of Histology, 2014, 5th Edn. Krishna Garg, Indira Bahl & Mohini Kaul CBS Publication & Distributors, Delhi.

2. Histology, 1987, 9th Edn., Arthur W. Ham, David H. Cormack, J. B. Lippincott Co. Philadelphia.

3. Histology, 1977, 4th Edn., R. O. Greep and L. Weiss, McGraw Hill Int. Book Co., New York.

4. Hand Book of Histo-pathogical & Histo-chemical Techniques, 1983, 3rd Edn. reprint, Butterworth & Co. (Publishers) Ltd, UK.

Subject Code-24 -ZO -353
Subject Name: Biological Chemistry

Total Contact Hours: 30 **Total Credits: 02**

Pre-Requisite:

- Students shall have the Knowledge of Basics of Biochemistry

Course Objectives:

- To understand functioning of biomolecules at cell and molecular level.
- To introduce the principles of biochemistry.

Course Outcomes:

- To understand the basic concepts and significance of biochemistry.
- To know the basic concepts pH and Buffers
- To learn the chemical structures of carbohydrate, and their biological and clinical significance.
- To analyse the structure and importance of proteins and lipids

To understand the variations in enzyme activity and kinetics.

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction of Biochemistry:** Importance of Biochemistry in Life Sciences	01
2	**Chapter 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. 2.5 Buffer - Definition, Concept, Functions, Types of buffer and Buffering Capacity..	03
3	**Chapter 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.	06

	3.4 Clinical Significance - Hypoglycemia and Hyperglycemia.	
4	**Chapter 4 :- Amino acids and Proteins** 4.1 General Structure of amino acids and Peptide bond. 4.2 Essential and non-essential amino acids. 4.3 Types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example), Forces responsible for their stability. 4.4 Biological importance of proteins – Biocatalysts, Carrier proteins Contractile proteins, Hormonal role of proteins.	06
5	**Chapter 5:- Enzymes** 5.1 Nomenclature, Types and properties of enzymes. 5.2 Regulatory and non-regulatory enzymes. 5.3 Ribozymes 5.4 Enzyme inhibition. 5.5 Factors influencing enzyme activity (pH, temperature, substrate concentration). 5.6 Introduction of isoenzymes and cofactor. 5.7 Clinical significance of enzymes - PKU and AKU. 5.8 Ribozymes 5.9 Industrial applications of enzymes	07
6	**Chapter 6:- Lipids** 6.1 Introduction. 6.2. Fatty acids - Types and nomenclature (saturated and unsaturated). 6.3 Clinical significance (obesity, atherosclerosis, myocardial infarction). 6.4 Biological importance of lipids. .	03

7	**Chapter 7:- Vitamins** 7.1 Fat soluble and water soluble 7.2 Dietary Sources, 7.3 Deficiency disorders 7.4 Biological functions	04
	Total Hours	30

Reference books

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: - 24 –ZO -354

Subject Name -: Genetics

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Genetics.

Course Objectives:

1. To learn and understand basics of Genetics.
2. To learn and know the functioning of genes.

Course Outcomes: On completion of the course, student will be able

1. To enable the students understand Mendelian inheritance.
2. To learn the concepts of Linkage.
3. To know the significance of organellar inheritance.
4. To understand the concept of sex determination and sex linked inheritance.

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction to genetics:** 1.1 Classical and Modern concept of Gene, Cistron, Muton, Recon. 1.2 Mendel's laws of Inheritance.	03
2	**Chapter 2 :- Exceptions to Mendelian Inheritance** 2.1 Incomplete dominance. 2.2 Co-dominance. 2.3 Multiple alleles: Concept, characteristics and importance of multiple. alleles, ABO & Rh - blood group system and its medico legal importance. 2.4 Lethal alleles.	06

3	**Chapter 3 :- Gene Mutation** 3.1 Definition. 3.2 Types of mutations: spontaneous, induced, somatic, gametic, forward, reverse. Types of point mutation - deletion, insertion, substitution, transversion, transition. 3.3 Mutagenic agents a) UV radiation and ionising radiation. b) Base analogs, alkylating and intercalating agents.	06
4	**Chapter 4 :- Sex-determination:** 4.1 Introduction. 4.2 Types of sex determination: -XX-XY, ZZ-ZW, XX-XO and Parthenogenesis, Hypodiploidy. 4.3 Gynandromorphism.	04
5	**Chapter 5:- Population Genetics** 5.1 Basic Concepts in population genetics: Mendelian population, gene pool, gene / allele, Frequency, chance mating (Panmictic mating). 5.2 Hardy Weinberg law and its equilibrium.	03
6	**Chapter 6:- Human Population Genetics** 6.1 Karyotype. 6.2 Genetic disorders, Structural & numerical alterations of chromosomes (chromosomal aneuploidy - Down, Patau, Edward, Turner and Klinefelter syndromes)	04
7	**Chapter 7:- Sex linked inheritance in human** 7.1 Colour – blindness. 7.2 Haemophilia. 7.3 Hypertrichosis.	02

8	**Chapter 8:- Application of genetics** 8.1 Genetic counselling. 8.2 Diagnostics & animal breeding technology	02
	Total Hours	30

Reference Books -

1. Principles of Genetics, 1997, P. D. Snustad, M. L. Simmons J. B. Jenkins, John Wiley & Sons, USA

2. Genetics, 2014, 9th Edn., Verma P. S. and Agarwal V. K., S. Chand and Co., New Delhi.

3. Genetics, 2014, 4th Edn. Gupta P. K., Rastogi Publications, Meerut.

4. Principles of Genetics, Gardner, E. J. et al. (2006), John Wiley and Sons Inc.

5. Genetics: A Molecular Approach, 3rd Edn, Russell, P. J., Benjamin Cummings.

6. Principles of Genetics 8th Edition, Gardner, E. J., Simmons, M. J., Snustad, D. P. (2008). John Wiley and Sons Inc.

7. Principles of Genetics. 5th Edn. Snustad, D. P. and Simmons, M. J. (2009). John Wiley and Sons Inc.

8. Concepts of Genetics, 10th Edn. Benjamin Cummings. Klug, W. S., Cummings, M. R. and Spencer, C. A. (2012).

9. An Introduction to Genetic Analysis, 11th Edn. Carroll S. B.; Doebley J., Griffiths, A. J. F. and Wessler, S. R. (2018) W. H. Freeman and Co. Ltd

Subject Code: - 24-ZO-355

Subject Name -: **Developmental Biology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Developmental Biology.

Course Objectives:

To learn and understand basics of Developmental Biology.
To learn and know how embryonic changes take place.

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.

Unit	Topic	No of lectures
1	**Chapter 1:- Fundamentals of Developmental Biology:** 1.1 Definition and scope. 1.2 Concepts in Developmental Biology: Growth, Differentiation, 1.3 Dedifferentiation, Cell determination, Cell Specification, Cell communication, Morphogenesis, Induction, Competence and Regeneration.	03

2	**Chapter 2 :- Theories of Developmental Biology** 2.1 Preformation. 2.2 Pangenesis. 2.3 Epigenesis. 2.4 Axial gradient. 2.5 Germplasm.	05
3	**Chapter 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	05
4	**Chapter 4 :- Fertilization:** 4.1 Concept and types. 4.2 Chemotaxis. 4.3 Sperm penetration: Acrosome reaction, Capacitation & Decapacitation. 4.4 Activation of ovum: Fertilization cone. 4.5 Prevention of polyspermy: Fast block & Slow block. 4.6 Significance of fertilization.	06
5	**Chapter 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.	05

	5.5 Definition and types of Blastula.	
6	**Chapter 6:- Gastrulation** 6.1 Definition and Concept. 6.2 Basic cell movements in gastrulation: Epiboly, Emboly, Convergence, Divergence, Invagination, Ingression & Involution, Delamination with reference to frog. 6.3 Concept of Organizer : Primary, Secondary and Tertiary.	03
7	**Chapter 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].	06
	Total Hours	30

Reference Books

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 John Wiley and Sons Inc.

Subject Code: - 24 –ZO-356

Subject Name -: **Medical Parasitology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Medical Parasitology.

Course Objectives:

To learn and understand basics of Medical Parasitology.
To learn and know how the parasite get associated with the host.

Course Outcomes:

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

1. To learn about basics and scope of parasitology.

2. To know the types of host and parasite with examples.

3. To understand about the morphology, life cycle, pathogenicity and treatment of common parasites (Protists and Platyhelminthes).

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

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction, Scope and Branches of Medical Parasitology:** 1.1. Definition: host, parasite, parasitoids, vector, commensalisms, mutualism and parasitism. 1.2. Branches of medical parasitology.	02

2	**Chapter 2 :- Types of Parasites and Hosts** 2.1 Ectoparasites. 2.2 Endoparasites and its subtypes. 2.3 Types of hosts - Intermediate, definitive, paratenic and reservoir.	03
3	**Chapter 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 host.	03
4	**Chapter 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.	08
5	**Chapter 5:- Study of Parasitic worms** 5.1 Ascaris lumbricoides - Study of Morphology, Life Cycle, Prevalence. 5.2 Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment. 5.3 Taenia solium (Tapeworm) - Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.	06

6	**Chapter 6:- Study of Parasitic Arthropoda** Morphology, pathogenicity and control measures of – 6.1 Soft tick. 6.2 Head louse. 6.3 Rat flea. 6.4 Bed bug.	03
7	**Chapter 7:- Zoonotic diseases- causative agents, modes of transmission**	03
8	**Chapter 8: Tools and techniques used in the diagnosis of parasites with reference to COVID**	02
	Total Hours	30

Reference Books:

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.

9. Textbook of medical parasitology – S. C. Parija.

10. Veterinary Parasitology, 2013 - (Taylor, M. A.).

11. Encyclopedia of parasitology, 2008.

12. The Biogeography of Host-Parasite Interactions by Serge Morand, Boris R. Kransov, Oxford University Press.

13. Textbook of medical microbiology – Rajesh Bhatia & Itchpujani.

Subject Code: - 24-ZO-357

Subject Name -: **Zoology Practical-I (2 Credits)**

Sr. No.	Name of the Practical	Demonstration / Experiment
1	**Section I: Practicals in Applied Entomology** Study of external characters of any Insect (Grasshopper / Cockroach / Plant bug)	E
2	Study of Insect Head, its articulations and types of mouthparts and their modifications	D
3	Study of Insect Legs, wing and their modifications	D
4	Study of Digestive system of any locally available insect pest	E
5	Study of Reproductive system of any locally available insect pest	E
6	Study of Social organization in Termites and Honey Bees	D
7	Study of Insect egg, larva, pupa and their types	D

8	Study of Insect vectors - Mosquito, House fly, Cockroaches, Bugs	D
9	Temporary mountings of Mouthparts, Antennae, Legs and Wings of any locally available insect pest.	E
10	Study of Preservation of Insect pest by using spreading techniques & submission of any five insect pests / vectors	E
11	Compulsory field visit to a Wildlife Sanctuary / National Park / Tiger Reserve /to study the Insect diversity	E
Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section II: Practicals in Histology and Histopathology** Study of the different types of tissues with the help of permanent slides – Epithelial tissue, Connective tissue, Muscular tissue and Nervous tissue	D
2	Study of permanent histological slides of T. S. of skin, V. S. of tooth and C. S. of tongue	D
3	Study of permanent histological slides of digestive parts – T. S. of Stomach, T. S. of Duodenum, T. S. of Rectum, C. S. of Liver	D
4	Study of permanent histological slides of glands - T. S. of Pituitary gland, T. S. of Thyroid gland, T. S. of Adrenal gland, C. S. of Pancreas	D
5	Study of permanent histological slides of reproductive organs- T. S. of Testis, C. S. of Ovary	D
6	Study of human blood smear to observe different types of blood cells	E
7	Temporary mounting of tissues of any mammal (freshly dissected or preserved) - Striated Muscle Fibre	E
8	Temporary mounting of tissues of any mammal (freshly dissected or preserved) - Smooth Muscle Fibre	E

Subject Code: - 24-ZO-358

Subject Name -: **Zoology Practical-II (2 Credits)**

Sr. No.	Name of the Practical	Demonstration / Experiment
1	**Section I: Practicals in Biological Chemistry** Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests	E
2	Isolation of starch from potato and digestion of starch by salivary amylase	E
3	Preparation of buffer of desired pH and molarity	E
4	Protein estimation by Lowry et al. method	E
5	Isolation of Caesin from milk by adjusting iso-electric point	E
6	Preparation of Acid, Alkali & it's standardisation	D
7	Principle, Working & Measurement of pH of any three samples	D
Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section II: Practicals in Genetics** Study of monohybrid ratio by providing hypothetical data and deducing applicability of Mendelian laws (Two examples)	D
2	Study of Dihybrid ratio by providing hypothetical data and deducing applicability of Mendelian laws (Two examples).	D

3	Study of genetic traits in human beings (tongue rolling, widow's peak, ear lobes, colour-blindness and PTC tasters/ non-tasters).	E
4	Study of blood groups in human (ABO and Rh).	E
5	Study of Hardy - Weinberg law with suitable recording of genetic traits	D
6	Study of human karyotypes and numerical alterations (simulated & theoretical sample data) (Down syndrome, Klinefelter syndrome and Turner syndrome)	D
7	Temporary preparation of polytene chromosomes from suitable material	E
8	Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides / photographs	D
9	Study of external characters, life cycle and Rearing of Drosophila	D
10	Study of Drosophila mutants	D

Subject Code: - 24-ZO-359

Subject Name -: **Zoology Practical-III (2 Credits)**

Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section I: Practicals in Developmental Biology** Study of ultrastructure of Sperm and Ovum of Mammal	D
2	Study of eggs with the help of slide / Photograph / chart / Model (Insect, Amphioxus, Frog and Hen).	D
3	Study of cleavage and its types with the help of Slide / Photograph / Chart / Model	D
4	Study of blastulae (Amphioxus, Frog and Hen).	D
5	Study of gastrulae (Amphioxus, Frog and Hen).	D
6	Study of whole mount slides of chick embryology – 24 hrs, 33 hrs and 48 hrs	D

7	Study of T. S. and V. S. of chick embryo of Brain & Heart with the help of slide / Photograph / chart / Model – 24 hrs & 33 hrs	D
8	Temporary preparation of chick embryo	E
9	Ex-ovo culture of chick embryo	D
Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section II: Practicals in Medical Parasitology** Study of parasitic association with their example - a) Commensalism. b) Parasitism	D
2	To study the life cycle, pathogenecity, diagnosis and treatment of *Entamoeba histolytica* and *Plasmodium vivax* through permanent slides or microphotographs.	D
3	To study the life cycle, pathogenecity, diagnosis and treatment of *Ascaris lumbricoides* and *Taenia solium* through specimen, permanent slides or microphotographS.	D
4	Study of following parasites with its role as vector - Soft tick, *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides or photographs	D
5	Study of effects of parasites on host body	D
6	Study of the pathogenecity and control measures of - Tick (soft tick and hard tick) and Mite (*Sarcoptes scabiei*).	D
7	Study of parasites from the gut of cockroach	D
8	Collection & submission of various parasites	E

Subject Code: - 24-ZO-3510

Subject Name -: **Fishery management**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Fisheries.

Course Objectives:

To learn and understand basics of Fishery Management.
To learn and know the fish diseases and diagnostic measures.

Course Outcomes:

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

1. The student will be able to identify and describe different species of fish with classification.

2. The student will be able to understand the Fish management.

3. The student will be able to understand different tools used in Fish management.

4. To encourage young learners for self-employment

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction to Fishery management:** 1.1 The potential scope of Fish Industry as a Cottage Industry. 1.2 Exotic and Endemic species of Fishes. 1.3 Various advantages of keeping fishes.	03

2	**Chapter 2 :- Biology of Fishes** 2.1 Common characters fresh water and marine fishes 2.2 Classification, History, Habit, Habitat of Fishes. 2.3 External morphology, body form, appendages, pigmentation, skin and scales.	03
3	**Chapter 3 :- Food and feeding of Fishes** 3.1 Use of live fish feed organisms. 3.2 Preparation and composition of formulated fish feeds. 3.3 Characteristics of fish feed. 3.4 Overview on types of fish food.	04
4	**Chapter 4 :- Maintenance of and management of Fish culture pond:** 4.1 General Maintenance - budget for setting up Fishery. 4.2 Fish Farm as a Cottage Industry, Rules & regulations of fish rearing. 4.3 Construction and management of ponds 4.4 Important tools for Fishery management	04
5	**Chapter 5:- Fish Transportation** 5.1 Live fish transport: a) Fish handling. b) Fish packing. c) Fish forwarding techniques.	04

	5.2 Causes of mortality in transport.	
6	**Chapter 6:- Fish preservation and Processing** 6.1 Fish preservation and processing. 6.2 Fish preservation techniques. 6.3 Biofloc technology 6.4 PMMSY- Government scheme for rearing of fishes	04
7	**Chapter 7:- Physico-chemical parameters of water for fish culture** 7.1Acidity, Alkalinity, Calcium, Nitrate, Ammonia, Total hardness	03
8	**Chapter 8: Fish Diseases and Management** 8.1 Protozoan diseases 8.2 Bacterial diseases 8.3 Fungal diseases 8.4 Viral diseases	05
	Total Hours	30

REFERENCES

1. Alappat, H.J. & A. Biju Kumar 1996. Aquarium Fishes (A Colourful Profile). B.R. Publ., Delhi, 106 pp.

2. Atz, W. 1971. Aquarium Fishes. Pelham Books Ltd., London, 110 pp.

3. Axelrod, H.R. & W. Vorderwinkler 1962. Encyclopedia of Tropical Fishes with Special Emphasis on Techniques of Breeding. TFH. Publ., Inc., NJ, 763 pp.

4. Biju Kumar, A. & H.J. Alappat 1996. A Complete Guide to Aquarium Keeping. Books for All, Delhi, 80 pp.

5. Dholakia, A.D. 2009. Ornamental fish Culture & Aquarium Management. Daya Publishing House, Delhi, 313pp.

6. Faulkner, D. & J.W. Atz 1971. Aquarium Fishes, Their Beauty, History and Care. Pelham Books, London, 110 pp.

7. Favre, H. 1977. Dictionary of the Freshwater Aquarium. Wardlock Ltd., London, 160 pp.

8. Frey, H. 1961. Illustrated Dictionary of Tropical Fish. TFH. Publ. Inc., NJ, 768 pp.

9. Gohm, D. 1984. Tropical Fish. Hamlyn Publ. Group Ltd., London, 143 pp.

10. Gopakumar G. 2011. Marine Ornamental fish Culture: Package of Practices. CMFRI Cochin. 100pp.

11. ICAR 2011. Handbook of Fisheries and Aquaculture. ICAR, New Delhi, 1116 pp.

Subject Code: - 24-ZO-3511

Subject Name -: **Poultry Management**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Poultry.

Course Objectives:

To learn and understand basics of Poultry Management.
To learn and know the different breeds of poultry.

Course Outcomes:

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

1. To understand the Poultry farming practices.

2. To know the poultry breeding techniques.

3. To understand feeding requirement and food ingredients.

4. To learn about the poultry disease and their pathogens.

5. To understand the market value of poultry products.

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction to Poultry Farming:** 1.1 Definition of Poultry, Importance of Poultry Farming and Poultry Development in India. 1.2 Present and future prospects.	02
2	**Chapter 2 :- Breeding Management** 2.1 Male and female reproductive system of chicken. 2.2 Breeds and strains of broilers and layers of chicken. 2.3 General aspects of breeding for better egg production and body weight gain. 2.4 Selection and culling. 2.5 Artificial insemination.	05

3	**Chapter 3 :- Housing Management** 3.1 Establishment of poultry farm. 3.2 Housing and equipment. 3.3 Incubation and hatching of eggs. 3.4 Broiler and layer management. 3.5 Lighting schedule for poultry. 3.6 Transport strategy of Poultry birds.	05
4	**Chapter 4 :- Feeding Management:** 4.1 Digestive system and Digestion Mechanism of chicken. 4.2 Feed ingredients. 4.3 Feed processing. 4.4 Formulation of feed viz., Starter, Grower, Layer, Finisher and Breeder ration, Feed conversion ratio (FCR), Nutritional deficiency conditions.	06
5	**Chapter 5:- Health Management** 5.1 Vaccination schedule for poultry birds. 5.2 Common poultry diseases, i. e. Ranikhet, Marek, Chicken pox, Gumboro, Infectious bronchitis and Chronic Respiratory Disease (CRD). 5.3 Control of internal and external parasites.	05

6	**Chapter 6:- Poultry Products** 6.1 Preservation and storage of eggs. 6.2 Grading of eggs and AGMARK standard of egg. 6.3 Egg powder. 6.4 Slaughtering and processing of chicken. 6.5 Poultry By Products – Feathers and Poultry Manure.	04
	Total Hours	30

Reference Books

1. Commercial Chicken Meat and Egg Production (2007), 5th Edn,Bell D. Donald and Weaver D. William Jr., Springer India Pvt. Ltd., Noida.

2. Poultry Science (2015) 3rd Edn, Ensmiger. M. E., International Book Distribution Co., Lucknow, India.

3. Modern Poultry Farming (2003), 1st Edn, Hurd M. Louis, International Book Distributing Company, Lucknow.

4. Handbook of Poultry Production and Management (2007), 2nd Edn., Jadhav N. V., and Siddique M. F., Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

5. Successful Poultry Management (2007), 2ndEdn, Jull A. Morley, Biotech Books, New Delhi.

6. Poultry Husbandry (2008) 2nd Edn, Jull A. Morley, J. V. Publishing House, Jodhpur, Rajasthan.

7. Broiler Breeder Production (2001), 1stEdn, Leeson. S., and Summers J. D. International Book Distributing Company, Lucknow.

8. Poultry and Ratite Nutrition (2013), 1stEdn, Pathak N. N., Narendra Publishing House, New Delhi, India.

9. Simply Poultry Science (2011) 1st Edn, Rajini Asha R., Alfa Publications, New Delhi.

SEMESTER VI

Subject Code: - 24-ZO-361

Subject Name -: **Medical & Forensic Zoology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Medical and Forensic Zoology

Course Objectives:

To learn and understand basics of Medical Zoology.
To learn and know the principles of Forensic Zoology.

Course Outcomes:

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

1. To understand the basics principles of Medical and Forensic Zoology.

2. To know the scientific methods in crime detection.

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

4. To analyse the fundamental principles and functions of forensic science and its significance to human society.

Unit	Topic	No of lectures
1	**Chapter 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	04

2	**Chapter 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 2.1 Preservation.	05
3	**Chapter 3: Diseases and their control** 3.1 Infectious diseases: Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Tuberculosis and Hepatitis 3.2 Non infectious Diseases: Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Diabetes (Type I and II), Hypertension, Hypotension, Obesity, 3.1 Atherosclerosis, Myocardial Infraction	04
4	**Chapter 4 :- Forensic Medicine** 4.1 Introduction to Forensic Medicine: Definitions of Forensic Medicine. 4.2 Medical Jurisprudence. 4.1 4.3 Medical evidence documentations.	05
5	**Chapter 5 :- Forensic analysis** 5.1 Examination of biological materials: Examination of Hair, Fibres, 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.	04

6	**Chapter 6:- Insects of forensic importance** 6.1 Forensic Importance of Insects 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.	03
7	**Chapter 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, 7.4 Miscellaneous poisons – Pesticides, Pharmaceutical drugs, Petroleum poisons, Food poisons, Radioactive poisons.	05
	Total Hours	30

Reference Books

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 brothers publishers.

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

Subject Code: - 24-ZO-362

Subject Name -: **Animal Physiology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Animal Physiology

Course Objectives:

To learn and understand basics of Animal Physiology
To learn and know the principles of Animal Physiology

Course Outcomes:

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

1. Define basic terms and concepts related to animal physiology.
2. Explain the structure and function of various organs systems in human body.
3. Explain the physiology of human reproduction and its hormonal control.
4. Explain the structure and function of endocrine glands.

Unit	Topic	No of lectures
1	**Chapter 1:- Nutrition and digestion:** 1.1 **Nutrition;** Nutritional requirement & balanced diet. 1.2 **Digestive system**; Digestion and absorption of carbohydrates, proteins and lipids.	05
2	**Chapter 2 :- Respiration** 2.1 **Respiratory system** 2.2. Mechanism of respiration: Regulation of ventilation in lungs, exchange of gases at respiratory surface. 2.3 Respiratory pigments in animals: Haemoglobin, Hemocyanin, Hemerythrin, Chlorocruorin.	05

3	**Chapter 3 :- Circulation** 3.1 Blood: Definition and its constituents, functions of blood. 3.2 Heart: Structure of human heart, Pace maker, Cardiac Cycle.	05
4	**Chapter 4 :- Excretion:** 4.1 **Excretory system; structure and function of kidneys.** 4.2 Mechanism of urine formation. 4.3 Normal and abnormal constituents of urine, Elementary idea of dialysis.	05
5	**Chapter 5:- Reproduction** 5.1 Physiology of male reproduction, hormonal control of spermatogenesis. 5.2 Physiology of female reproduction, hormonal control of menstrual cycle.	04
6	**Chapter 6:- Endocrine Glands** 6.1 Structure and functions of hypothalamus, pituitary, thyroid, parathyroid, pancreas and adrenal glands.	03
	Total Hours	30

Reference Books

1. Textbook of Medical Physiology, Guyton A. C. & Hall J. E., 2006, 11th Edition, Hercourt Asia Pvt. Ltd. / W. B. Saunders Company

2. Principles of Anatomy & Physiology, 2006, 11th Edition, Tortora G. J. & Grabowski S., John Wiley & sons, Inc.

3. Haematology: De Gruchi.

4. Human physiology, Vol. I & II, 1980, 12th Edn. Dr. C. C. Chatterjee, Medical Applied Agency, Kolkata

5. Text book of Animal Physiology, 2008, 2nd Edn. Nagabhushanam, S. V. S. Rana, S. Kalavathy, Oxford University Press, India.

6. Animal Physiology: Adaptation and Environment, 1997, Schmidt-Nielsen, Knut, Cambridge University Press.

7. General and Comparative Physiology, 1983, 3rd Edn., Hoar W. S., Prentice Hall, UK.7.

8. Medical Physiology, 2006, Asis Das, Books and Allied Pvt. Ltd., Kolkata.

9. Endocrinology, 2005, Lohar P. S., M J P Publishers, Chennai.

10. Vander, Sherman, Luciano's Human Physiology: The Mechanisms of Body Function, 2003, 9th Edn., Eric P. Widmaier, Hershel Raff, Kevin T. Strang, Mc Graw H.

11. Tortora, G. J. and Derrickson, B. H. (2009) Principles of Anatomy and Physiology (12th edition) John Wiley and Sons, Inc.

12. Widmaier, E. P., Raff, H. and Strang, K. T. (2008) Vander's Human Physiology (9th edition) McGraw Hill.

13. Human Anatomy and Physiology, (1998) Marieb, E. (4th edition) Addison-Wesley.

14. Experimental Physiology, (2007) Kesar, S. and Vashisht, N., Heritage Publishers.

Subject Code: - 24-ZO-363

Subject Name -: **Molecular Biology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of Molecular Biology

Course Objectives:

To learn and understand basics of Molecular Biology
To learn and know the principles of Molecular Biology

Course Outcomes:

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

To get an insight into molecular mechanisms of various biological processes in cells and organisms

2. To know the Structure of DNA and RNA, DNA and RNA as genetic material

3. To understand the Central Dogma of Molecular Biology

4. To know the concept of gene regulation

Unit	Topic	No of lectures
1	**Chapter 1:- Nucleic Acids and Chromatin:** 1.1 Structure of RNA & DNA. 1.2 Types of RNA. 1.3 DNA as genetic material - evidences (Griffith's, Avery et al., Hershey and Chase experiment), RNA as genetic material - TMV 4. 1.4 Structure of Chromatin, packaging of DNA, Heterochromatin, Euchromatin.	07
2	**Chapter 2 :- Central Dogma of Molecular Biology** 2.1 DNA Replication - Semiconservative (Messelson and Stahl experiment), Basic mechanism of replication in prokaryotes and eukaryotes. 2.2 Transcription - 2.2.1 Basic mechanism of transcription in prokaryotes and eukaryotes, RNA polymerase enzyme in prokaryotes. 2.2.2 RNA modifications and processing (splicing - mRNA, modifications at 3'and 5' end). 2.3 Translation - Genetic code, properties of genetic code, Basic mechanism of Translation in E. coli and eukaryotic cells.	15
3	**Chapter 3 :- Lac operon**	01

4	**Chapter 4 :- DNA repair mechanism** Photo repair, dark repair, base excision repair.	03
5	**Chapter 5:- Recombinant DNA Technology** Introduction, restriction enzymes, cloning vector, PCR (polymerase chain reaction), DNA finger printing.	04
	Total Hours	30

Reference Books:

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.

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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: - 24-ZO-364

Subject Name -: **Pest Management**

Total Hours :- 30 **Total Credits:2**

Prerequisites:

The students should have a basic knowledge of Pest Management

Course Objectives:

To learn and understand basics of Pest Management
To learn and know the principles of Pest Management

Course Outcomes:

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

1. Define pest management.

2. Describe the economic, ecological, and sociological benefits of IPM.

3. Understand problems resulting from misuse, overuse, and abuse of chemical pesticides.

4. Define and describe pesticide resistance and how it develops.

5. Analyse and compare management tactics to determine the best approach to reducing pest populations, weeds, and disease presence.

Unit	Topic	No of lectures
1	**Chapter 1:- Pest:** 1.1. Definition. 1.2. Types of pests. 1.3. Types of damages caused by the pest.	02

2	**Chapter 2 :- Pest management using Regulatory control** 2.1. Quarantine. 2.2. Eradication. 2.3. Control districts. 2.4. "Crop-free" periods.	04
3	**Chapter 3 :- Pest management using Cultural control** 3.1. Sanitation. 3.2. Tillage. 3.3. Crop rotation. 3.4. Cropping systems.	04
4	**Chapter 4 :- Pest management using Biological control** 4.1. Ecological considerations. 4.2. Biological control of insects. 4.3. Biological control of plant disease. 4.4. Biological control of weeds.	04
5	**Chapter 5:- Biotechnology approaches in pest management** 5.1. Introduction. 5.2. Recent advance in use of fungi and viruses. 5.3. Methodology in Biotechnology. 5.4. Somaclonal variability.	04

	5.5. Concept of Genetic engineering and Transgenic plants.	
6	**Chapter 6: Integrated Pest Management (IPM)** 6.1. Principles and its components. 6.2. Advantages and disadvantages. 6.3. Biological control - Predators, Parasitoids, Entomopathogens, Weed killers and their mass production.	05
7	**Chapter 7: Insecticides** 7.1. Classification of insecticides based on mode of entry. 7.2. Action and chemical nature. 7.3. Insecticides formulations and their uses. 7.4. Safe handling of insecticides.	04
8	**Chapter 8: Insecticide residue** 8.1. Methods of residue detection – Organochlorine, Organophosphates, Synthetic Pyrithroides, Systemic. 8.2. Problems in fruits, vegetables, medicinal plants. 8.3. Maximum permissible residue limits (MRLs).	03
	Total Hours	30

Reference Books :

1. Handbook of Pest Management in Agriculture by Pimentel.

2. Principles of Insect Pest Management by Dhaliewal and Arora.

3. Agricultural Pest of India & South East Asia by A. Satwal.

4. Pathological Problems of Economics Crop Plants & their Management by Paul Khurana, S. M., 1998.

5. Integrated Diseases Management and Plant Health by Gupta V. K. & Sharma R. C.

6. Diseases of Millets by Ramkrishnan T. S., I. C. A. R. Publ. New Delhi.

7. Fungal diseases of Rice in India by Padmanabhan S. Y., I. C. A. R. Publ., New Delhi.

8. Analysis of Pesticides Residues by H. A. Moye (JW)

9. Advance in Pest Control Research by R. L. Methcalf (JW)

10. Chemistry of pesticides by K. H. Buchel (JW).

11. Progress in Pesticides Biochemistry and Toxicology Vol. I, II & III by D. H. Hutsonand

T. R. Robert.

12. Evaluation of Pesticides in Ground Water by W. Y. Garnett, R. C. Honeycatt and others.

13. Chemistry of Pesticides by Edward

14. Insecticide Biochemistry and Physiology by C. F. Wilkinson.

Subject Code: - 24-ZO-365

Subject Name -: **Techniques in Biology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of different techniques used in Biology

Course Outcomes:

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

1. Define biological techniques.

2. Describe the principle, working and use of different types of microscope.

3. Understand different haematological and immunological techniques.

4. Define and describe the technique of PCR .

5. Analyse and compare management tactics to determine the biodiversity.

Unit	Topic	No of lectures
1	**Chapter 1:- Microscopy** 1.1 Definitions - Resolving Power, Limit of Resolution and Magnification,Numerical Aperture. 1.2 Basic principle of microscopes - Light, Fluorescence, Phase Contrast,Stereo Microscope, SEM and TEM. 1.3 Principle and working of camera lucida	05
2	**2. Chapter 2 :- Microtomy: Tissue fixation and Processing** 2.1 Methods of tissue fixation: Chemical fixation and physical fixation. 2.2 Procurement of tissue and importance of fixation of tissues. 2.3 Dehydration, clearing, impregnation, embedding and block making. 2.4 Types of microtomes. 2.5 Section cutting: steps and precautions**,** common faults in section cutting,reasons & remedies. 2.6 Mounting and spreading of ribbons. 2.7 General procedure for staining of sections. 2.8 Demonstration of Nucleic acid (Feulgen Reaction).	08

3	**Chapter 3 :- Haematological Techniques** 3.1 Total count of RBCs, WBCs and Differential count of WBCs and significance. 3.2 Bleeding time, clotting time and their significance.	02
4	**Chapter 4 :- Immunological Techniques** 4.1 4 Antigen-Antibody Interactions – Immunodiffusion (Ouchterlony) 4.2 Principle & Working of ELISA.(Direct and Indirect ELISA) 4.3 Hybridoma technology 4.4 Application of Immunological techniques in disease diagnosis	04
5	**Chapter 5:- Types of PCR & DNA Barcoding** 4.1 Introduction to PCR 4.2 Types of PCR 4.3 Technique of DNA Barcoding	02
6	**Chapter 6: Methods in Biodiversity** Introduction to sampling and sample size and measuring biodiversity Quadrat sampling, Transect sampling, Insect survey - Active (sweep netting, aquatic nets) and Passive methodology(Pit fall traps, Light traps).	03
7	**Chapter 7: Bioinformatics** 7.1 Introduction to Bioinformatics Internet and Web site, Search engines and computer programs useful in Biology 7.2 Definition - Bioinformatics Applications and Research -Bioinformatics 7.3 Three levels of Bioinformatics in structural Biology, Applications of Bioinformatics in life sciences 7.4 Tools used in Bioinformatics and Types of sequences used in Bioinformatics 7.5 Introduction to biological databases, types of databases, Biological Databases, Pitfalls of Biological Databases, Information Retrieval from Biological Databases Databases - Characteristics - Categories - Navigating Databases – Information,	06

	Biological Databases and Tools: Primary and Secondary Databases, NCBI, EBI, ExPASY, Pub Med, OMIM, Primary sequence databases, Nucleic acid sequence databases (GenBank, EMBL-EBI, DDBJ)	
	Total Hours	30

References:

1. *Welch*, P. S. 1948. *Limnological* Methods. Blakiston Philadelphia. 381 pp.
2. Wetzel, R. G. 1983. *Limnology*. 2nd Ed. Saunders ColI. Philadelphia.
3. Wilson, E. O. (1992). *The Diversity of Life*. Cambridge, Mass, Belknap Press of HarvardUniversity Press.
4. Krebs C. J., 2009. Ecology. Benjamin-Cummings Publishing Company or PearsonInternational Edition
5. Eugene P. Odum and Gary W. Barrett. Fundamentals of Ecology Brooks / Cole; 5th Revisededition.
6. Suzanne Bell, Keith Morris. An Introduction to Microscopy. CRC press.
7. *Kato*, M. The Biology of Biodiversity. Springer.
8. Robert Smith and Thomas M. Smith Ecology and Field Biology.
9. Bikram Grewal *et al.*, A Photographic Field Guide to the Birds of India, Pakistan, Nepal,Bhutan, Sri Lanka, and Bangladesh. Princeton University Press.

Subject Code: - 24-ZO-366

Subject Name -: **Evolutionary Biology**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of different techniques used in Evolutionary

Biology

Course Outcomes:

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

To learn most of the essential aspects of Evolutionary Biology in detail which will help them in acquiring better understanding regarding the subject.

2. Explain important processes, principles and concepts and critically evaluate theories and empirical research within evolutionary biology

3. Apply evolutionary theory and concepts to address empirical and theoretical questions in evolutionary biology.

4. Investigate evolutionary questions using literature and analyses of empirical data.

5. Communicate the principles, theories, problems and research results associated with questions that lie within the evolutionary framework to students

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction** 1.1 Concept of Evolution. 1.2 Origin of life. 1.3 Origin of eukaryotic cell (Origin of mitochondria, plastids & symbionts).	03
2	**Chapter 2 :- Evidences of Evolution** 2.1 Analogy and Homology. 2.2 Embryological Evidences of Evolution. 2.3 Evolutionary & Paleontological Evidences.	04

3	**Chapter 3 :- Historical Review of Evolutionary Concept** 3.1 Theories of Evolution. 3.2 Lamarckism. 3.3 Darwinism and Neo Darwinism. 3.4 Mutation Theory. 3.5 Modern Synthetic theory.	03
4	**Chapter 4 :- Sources of Variations** 4.1 Variation and Mutations.	03
5	**Chapter 5:- Isolation**	04
6	**Chapter 6: Speciation** 6.1 Types of speciation (Allopatric & Sympatric). 6.2 Mechanism of speciation. 6.3 Patterns of speciation. 6.4 Factors influencing speciation.	04
7	**Chapter 7: Molecular Evolution** 7.1. Gene evolution 7.2. Evolution of gene families, molecular drive 7.3. Amino acid sequence divergence in proteins 7.4. Nucleotide sequence divergence in DNA 7.5. Molecular clocks	04

	7.6. Ancient DNA.	
8	**Chapter 8: Origin of Man** 8.1 Evolution of Man (Evolution of anthropoids including man) - Kenyapithecus to Homo sapiens.	03
9	**Chapter 9: Zoogeographical Realms With reference to fauna**	02
10	**Chapter 10: Extinctions** 10.1 Extinction - An Overview.	02
	Total Hours	30

Subject Code: - 24-ZO-367

Subject Name -: **Zoology Practical-I (2 Credits)**

Sr. No.	Name of the Practical	Demonstration / Experiment
1	**Section I: Practicals in Forensic Zoology** . To carry out routine analysis of given urine sample for - 2 i. Physical Properties: Volume, Colour, pH, Turbidity, Specific gravity. ii. Chemical Properties: Sugars, Protein, Bile salts & bile pigments, Ketone bodies, E	E

	Blood. (C)	
2	Determination of serum urea	E
3	Determination of serum uric acid	E
4	Determination of serum Calcium	E
5	To examine human hair for cortex and medulla	E
6	To examine hair morphology and determine the species to which the hair belongs	E
7	To prepare slides of scale pattern of human hair	E
8	To Visit a Forensic Laboratory and submission of the report	E
9	To Identify and differentiate various types of Finger prints	E
10	To prepare a case report on forensic entomology with respect to insect's succession and its relationship to determine time since death	E
Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section II: Practicals in Animal Physiology** Haemoglobin estimation using Sahli's haemoglobinometer	E
2	Preparation of haemin and haemochromogen crystals	E
3	To estimate the blood glucose level from given sample	E
4	Estimation of bleeding and clotting time	E
5	Study of disorders caused by endocrine glands with the help of photographs	D
6	Detection of blood groups in human being	E

7	Differential count of blood	E
8	Estimation of haemoglobin percentage with the help of haemometer	E
9	Qualitative detection of nitrogenous waste products (Ammonia, urea, uric acid) in given sample	E
10	Demonstration of kymograph unit, Respirometer through available resources	E
11	Measurement of lung capacity	E

Subject Code: - 24-ZO-368

Subject Name -: **Zoology Practical-II (2 Credits)**

Sr. No.	Name of the Practical	Demonstration / Experiment
1	**Section I: Practicals in Molecular Biology** Lab safety techniques & sterilisation.	D
2	Staining of DNA and RNA by methyl green – pyronin.	E
3	Estimation of DNA by Diphenylamine method	E
4	Estimation of RNA by Bial's Orcinol method	E
5	Isolation of DNA from Bacteria / liver / Onion/Banana	E
6	Absorption spectra of DNA isolated from Bacteria / Liver / Onion/ Banana	E

7	Principle & application of Spectrophotometer & PCR	D
Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section II: Practicals in Pest Management** To study the plant protection appliances	D
2	Studies on beneficial insects.	D
3	Study of pests and diseases of honeybees	D
4	Applications of IPM components in various crops	D
5	Separation of the pesticides or plant products by TLC and Column chromatography.	E
6	Detection of pesticides residues in food stuffs	E
7	Rearing of pest species (Any 2 species).	D
8	Study of life cycle of Red cotton bug and Lemon butterfly	D
9	Study of the detection of damage caused by pests	D
10	Plant disease, its intensity & calculation of VI (Virulence Index) of at least two diseases	D

Subject Code: - 24-ZO-369

Subject Name -: **Zoology Practical-III (2 Credits)**

Sr. No.	**Name of the Practical**	**Demonstration / Experiment**

1	**Section I: Practicals in Tools and techniques in Biology** Compound and Stereo microscope: Components, usage and maintenance	D
2	To observe different kind of cells under compound microscope and its measurement using micrometer scale or by image analysis software (Ex. Image J).	E
3	Tissue collection, fixation & Block preparatioN	E
4	Sectioning, staining & mounting. Submission of any three permanent slides from three different organs	E
5	Introduction to Biological databases- DNA/ Protein (any 2 of each)	E
6	Retrieving of gene /protein sequence using NCBI	E
7	Survey for insects using pit fall trap and light traps in your college campus / agriculture field.	E
8	Visit to a water body / forest to study faunal biodiversity using field equipment	E
9	Study of Principle & working of PCR & DNA Barcoding	E
Sr. No.	**Name of the Practical**	**Demonstration / Experiment**
1	**Section II: Practicals in Evolutionary Biology** Study of morphological similarities and differences between man and ape	D
2	Study of types of fossils with the help of specimens/ charts/ photos	D
3	Study of animal adaptations in: Turtle, Draco, Exocoetus, Bat and Parrot	D
4	Study of evidences of evolution- embryological, paleontological, connecting links, morphology and comparative anatomy	E
5	Study of successive stages of evolution of man: a) Australopithecus b) Homo erectus	D

	c) Homo neanderthalis d) Cro-Magnon man e) Homo sapiens.	
6	To record Zoogeographical distribution of animals to respective zoogeographical Realms on the world map (Lung fishes, marsupials, flightless birds, Camel, Elephant,Ostrich etc.).	E

Subject Code: - 24-ZO-3610

Subject Name **Biodiversity Assessment**

Total Hours :- 30 **Total Credits: 02**

Prerequisites:

The students should have a basic knowledge of different techniques used in Biodiversity Assessment.

Course Outcomes:

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

Understanding the basics of science of biodiversity in an ecological context.

2. Learning tools and techniques relevant to monitoring of biological diversity.

3. Imparting basic knowledge about the environment and its allied problems.

4. Developing an attitude of concern for the environment.

5. Make one striving to attain harmony with Nature, acquiring skills to help the concerned individuals in identifying and solving environmental problems.

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction** 1.1 Definition of biodiversity 1.2 Clarification of terms (taxonomic, spatial levels, endemism), levels of biodiversity (microbial, genetic, species, ecosystem, landscape), drivers of biodiversity).	03
2	**Chapter 2 :- Magnitude and Distribution of biodiversity Evolution of biodiversity** 2.1 Overview of ecological communities, number of species worldwide, change in biodiversity over time in different regions of the world 2.2 Concept of diversity hot-spots; Biodiversity in India: In the past and present	04
3	**Chapter 3 :- Assessment and Monitoring of biodiversity Indicators for Biodiversity** 3.1 Methodology of assessment and analysis of different species groups, monitoring of different species groups.	03
4	**Chapter 4 :- Biodiversity–ecosystem functioning–Ecosystem Services (ES)** 4.1 Ecosystem functions related to biodiversity, definition of ES 4.2 Importance of biodiversity ecosystem functioning for supply of ES (direct and indirect), methods of valuation 4.1 Variation and Mutations.	04

5	**Chapter 5:- Biodiversity loss and its consequences** 5.1 Estimates of extinction rates worldwide and in India. 5.2 Analysing and discussion of causes and extinction/changes in biodiversity 5.3 Summarising causes and consequences (Causes: Vulnerability to extinction; changing of the environment (Habitat fragmentation and destruction) climate change, overexploitation; Consequences: loss of gene pool, loss of ecosystem services, livelihood)	06
6	**Chapter 6: Conservation strategies** Theoretical background: overview of genetic variability: population biology of endangered species, conservation genetics, wildlife biology 6.1 Ex-situ conservation 6.2 In-situ conservation	06
7	**Chapter 7: Biodiversity restoration** Principles, definitions, degradation, tools and methods, restoration and ecosystem functioning, discussion of case studies	04
	Total Hours	30

REFERENCE BOOKS

- Guide to India's wild life A.N.Jagnnath Rao
- Biodiversity .E.O Wilson ,Academic Press 1988
- Biodiversity status and prospects by Tandon.
- An Introduction to Biodiversity. Prithipalsingh
- Biodiversity and biotechnology. Ray
- Biodiversity and its significance. Y.A. Abrol
- Conservation Biology S.K. Jain
- The Preservation of species: The value of Biological Diversity by Norton B.G.

Subject Code: 24-ZO-3611

Subject : Project/Internship/Hands on Training or Workshop

Chairman,

Board of Studies in Zoology