M.Sc. ZOOLOGY: COURSE CODES AND TITLES

SEMESTER –I	SEMESTER-II
ZOO-CC-411: Biology of Invertebrates	ZOO-CC-421: Biology of Vertebrates
ZOO-CC-412: Biosystematics and Evolution	ZOO-CC-422: Cell and Molecular Biology
ZOO-CC-413: Human Physiology	ZOO-CC-423: Bio-techniques
ZOO-AEC-414: Biostatistics, Computer application and Bioinformatics	ZOO-CC-424: Concept of Immunology
ZOO-CC-415 (P): Practical-I (Based on Paper ZOO-CC-411, ZOO-CC-412 and ZOO-CC-413)	ZOO-OE-425: Economic Zoology
ZOO-AEC-416 (P): Practical-II (Based on Paper ZOO-AEC-414)	ZOO-CC-426 (P): Practical-III (Based on Paper ZOO-CC-421and ZOO-CC-422)
ZOO-CC-501: Seminar	ZOO-CC-427 (P): Practical-IV (Based on Paper ZOO-CC-423 and ZOO-CC-424)
SEMESTER-III	**SEMESTER-IV**
ZOO-CC-431: Developmental Biology	ZOO-CC-441: Biochemistry
ZOO-CC-432: Genetics	ZOO-EC-442: Environmental Biology-I OR ZOO-EC-443: Entomology-I OR ZOO-EC-444: Fish, Fisheries and Aquaculture-I
RM-CC-022: Research Methodology	ZOO-EC-445: Environmental Biology-II OR ZOO-EC-446: Entomology-II OR ZOO-EC-447: Fish, Fisheries and Aquaculture-II
ZOO-OE-433: Ecology	
ZOO-EC-434: Applied Zoology OR ZOO-EC-435: Animal Behavior and wildlife conservation OR ZOO-EC-436: Basic Endocrinology	
ZOO-CC-437 (P): Practical-V (Based on Paper ZOO-CC-431, ZOO-CC-432 and RM-CC-022)	ZOO-CC-448 (P): Practical-VII (Based on Paper ZOO-CC-441)

ZOO-EC-438 (P): Practical-VI A)Based on Paper ZOO-EC-434 OR B) Based on paper ZOO-EC-435 OR C) Based on paper ZOO-EC-436	ZOO-EC-449(i)(P): Practical-VIII A) Based on Paper ZOO-EC-442 OR B) Based on paper ZOO-EC-443 OR C) Based on paper ZOO-EC-444
	ZOO-EC-449(ii)(P): Practical-IX A) Based on Paper ZOO-EC-445 OR B) Based on paper ZOO-EC-446 OR C) Based on paper ZOO-EC-447
	ZOO-CC-502: Project

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Sr. No.	Nature of course	Code	Number
1	Ability Enhancement course	AEC	1
2	Core Course	CC	18
3	Open elective	OE	2
4	Discipline Elective/Generic Elective	EC	18

Sr. No.	Semester	Credit
1	Semester-1	24
2	Semester-II	26
3	Semester-III	24
4	Semester-IV	24
	Total	**98**

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Sri Sai University, Palampur

Scheme of Examination for M.Sc. Zoology (Semester system) as per Choice Based Credit System (CBCS)

Semester wise distribution of course and credits in Zoology

SEMESTER-I

Paper Code	Title of the Paper	Nature of Paper	Credits	Contact Hours per week			Total Marks			Total Marks
				T	S	P	T	P	IA	
ZOO-CC-411	Biology of Invertebrates	Core	4	4	0	0	60	0	40	100
ZOO-CC-412	Biosystematics and Evolution	Core	4	4	0	0	60	0	40	100
ZOO-CC-413	Human Physiology	Core	4	4	0	0	60	0	40	100
ZOO-AEC-414	Biostatistics, Computer application and Bioinformatics	AEC	4	4	0	0	60	0	40	100
ZOO-CC-415 (P)	Practical-I (Based on ZOO-CC-411, ZOO-CC-412 and ZOO-CC-413)	Core	4	0	0	8	0	100	0	100
ZOO-AEC-416 (P)	Practical-II (Based on ZOO-AEC-414)	AEC	2	0	0	4	0	100	0	100
ZOO-CC-501	Seminar	Core	2	0	2	0	0	0	50	50
Total			**24**	**16**	**2**	**12**				**650**

Abbreviations: T- Theory, S- Seminar, P- Practical, IA- Internal Assessment, AEC- Ability Enhancement course

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SEMESTER-II

Paper Code	Title of the Paper	Nature of Paper	Credits	Contact Hours per week			Total Marks			Total Marks
				T	S	P	T	P	IA	
ZOO-CC-421	Biology of Vertebrates	Core	4	4	0	0	60	0	40	100
ZOO-CC-422	Cell and Molecular Biology	Core	4	4	0	0	60	0	40	100
ZOO-CC-423	Bio-techniques	Core	4	4	0	0	60	0	40	100
ZOO-CC-424	Concept of Immunology	Core	4	4	0	0	60	0	40	100
ZOO-OE-425	Economic Zoology	Open Elective	2	2	0	0	30	0	20	50
ZOO-CC-426 (P)	Practical-III (Based on ZOO-CC-421 and ZOO-CC-422)	Core	4	0	0	8	0	100	0	100
ZOO-CC-427 (P)	Practical-IV (Based on ZOO-CC-423 and ZOO-CC-424)	Core	4	0	0	8	0	100	0	100
Total			**26**	**18**	**0**	**16**				**650**

Abbreviations: T- Theory, S- Seminar, P- Practical, IA- Internal Assessment, OE- Open Elective

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SEMESTER-III

Paper Code	Title of the Paper	Nature of Paper	Credits	Contact Hours per week			Total Marks			Total Marks
				T	S	P	T	P	IA	
ZOO-CC-431	Developmental Biology	Core	4	4	0	0	60	0	40	100
ZOO-CC-432	Genetics	Core	4	4	0	0	60	0	40	100
RM-CC-022	Research Methodology	Core	4	4	0	0	60	0	40	100
ZOO-OE-433	Ecology	Open Elective	2	2	0	0	30	0	20	50
ZOO-EC-434	Applied Zoology	Elective (Choose any one)	4	4	0	0	60	0	40	100
ZOO-EC-435	Animal Behavior and Wildlife conservation									
ZOO-EC-436	Basic Endocrinology									
ZOO-CC-437 (P)	Practical-V(Based on ZOO-CC-431, ZOO-CC-432 and RM-CC-022)	Core	4	0	0	8	0	100	0	100
ZOO-EC-438 (P)	Practical-VI A) Based on ZOO-EC-434 OR B) Based on ZOO-EC-435 OR C) Based on ZOO-EC-436	Elective	2	0	0	4	0	100	0	100
Total			**24**	**18**	**0**	**12**				**650**

Abbreviations: T- Theory, S- Seminar, P- Practical, IA- Internal Assessment, OE- Open Elective, EC- Elective

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SEMESTER-IV

Paper Code	Title of the Paper	Nature of Paper	Credits	Contact Hours per week			Total Marks			Total Marks
				T	S	P	T	P	IA	
ZOO-CC-441	Biochemistry	Core	4	4	0	0	60	0	40	100
ZOO-EC-442	Environmental Biology-I	Elective (Chose any one)	4	4	0	0	60	0	40	100
ZOO-EC-443	Entomology-I									
ZOO-EC-444	Fish, Fisheries and Aquaculture-I									
ZOO-EC-445	Environmental Biology-II	Elective (Chose any one)	4	4	0	0	60	0	40	100
ZOO-EC-446	Entomology-II									
ZOO-EC-447	Fish, Fisheries and Aquaculture-II									
ZOO-CC-448 (P)	Practical-VII (Based on ZOO-CC-441)	Core	2	0	0	4	0	100	0	100
ZOO-EC-449(i)(P)	Practical-VIII A)Based on ZOO-EC-442 OR B)Based on ZOO-EC-443 OR C)Based on ZOO-EC-444	Elective	2	0	0	4	0	100	0	100
ZOO-EC-449(ii)(P)	Practical-IX A)Based on ZOO-EC-445 OR B) Based on ZOO-EC-446	Elective	2	0	0	4	0	100	0	100

	OR C)Based on ZOO-EC-447									
ZOO-CC-502	Project Presentation	Core	6	0	0	6	0	0	150	150
Total			**24**	**12**	**0**	**18**				**750**

Abbreviations: T- Theory, S- Seminar, P- Practical, IA- Internal Assessment, OE- Open Elective, EC- Elective

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SEMESTER-I

COURSE CODE: ZOO-CC-411

L	S	P	Hrs
4	0	0	4

COURSE NAME: BIOLOGY OF INVERTEBRATES

Course Objectives	The course objectives to provide students with a basic understanding of: ● Basis of classification ● Different physiological body processes of invertebrates ● Larval forms of invertebrates ● Minor Phyla
Course Outcomes	By the end of the course, students should be able to: ● Describe basis of classification ● Describe different physiological body processes of invertebrates ● Describe Larval forms of invertebrates ● Describe the life history of various parasites and its adaptations

MODULE I

1. General characteristics and outline classification of Invertebrates up to classes with examples.
2. Locomotion: Flagellar and Ciliary movement in Protozoa.
3. Hydrostatic movement in Annelida and Echinodermata
4. Pathogenic protozoans: Life cycle of *Plasmodium vivax.*

MODULE II

5. Skeleton and Canal system in Sponges.
6. Patterns of feeding and digestion in lower metazoa
7. Filter feeding in Polychaeta, Mollusca and Echinodermata
8. Polymorphism in Coelenterates, corals and coral reefs.

MODULE III

9. Organs of excretion: Coelom, Nephridia and Malphigian tubules.
10. Mechanism of excretion in higher invertebrates.
11. Primitive Nervous System (Coelenterates and Echinodermata).
12. Advanced nervous system: Annelida and Mollusca (Cephalopoda).

MODULE IV

13. Advanced nervous system: Arthropoda (Crustacea and Insecta)
14. Respiratory pigments
15. Organs of respiration: Gills, lungs and trachea.
16. Larval forms of Mollusca and Echinodermata.

MODULE V

17. Life history of *Fasciola* and its parasitic adaptation
18. Life history of *Taenia* and its parasitic adaptation.
19. Life history of *Ascaris* and its parasitic adaptation.
20. Life history of *Ancyclostoma* and its parasitic adaptation.

Suggested Reading:

1. Jordan, E.L and P.S. Verma. 1995, Invertebrate Zoology and elements of animal physiology, S. Chand and Co. Ltd. NewDelhi.
2. Ayyar, E.K and T. Ananthakrishnan, 1992. Manual of Zoology Vol.1 Invertebrates Part I and II, S. Viswanathan Printers and Publishers Pvt. Ltd. Madras.
3. Kotpal, R.L. 1992. (All Series). Rastogi Publications, Meerut.
4. Nair, N.C., N. Arumugam, N. Soundarapandian, T. Murugan and S. Leelavathy. 2010. A text book of Invertebrates. Saras Publication, Nagercoil.

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-412

L	S	P	Hrs
4	0	0	4

COURSE NAME: BIOSYSTEMATICS AND EVOLUTION

Course Objectives	The course objectives to provide students with a basic understanding of: ● Salient features of Taxonomy and Evolution. ● The evolutionary relationships on the basis of anatomy, physiology, etc. ● It is used for the classification of the organisms/plants on the basis of their history and phylogenetic studies in order to place them in a specific hierarchical rank. ● Analytical tools, such as phylogenetics and population genetics, that are used in diagnostics to identify pathogens, trace sources of infection, determine patient ancestry, and interpret genetic markers of disease risk.
Course Outcomes	By the end of the course, students should be able to: ● Understand the patterns and processes of evolution above the species level ● Appreciate the differences between the three methods of phylogenetic analysis: evolutionary systematics, phenetics, cladistics.

MODULE I

1. Definition, History, Need and Importance of Taxonomy.
2. Trends in biosystematics: cytotaxonomy, and numerical Taxonomy.
3. Species concept: Morphological, Biological, Polytypic, Monotypic
4. Zoological Nomenclature: Code, Priority and Binominal Nomenclature.

MODULE II

5. Taxonomic collections.
6. Sample preservation.
7. Curetting and identification.
8. Hierarchy of Categories: Taxonomic keys and higher taxa.

MODULE III

9. Theories of Origin of life.
10. Origin of Universe: Solar system, Primitive atmosphere and Simple organic compound.
11. Theories of organic and Biological evolution.
12. Geological time scale.

MODULE IV

13. Origin of the molecules of life and first cell and Organisms.
14. Evolution of eukaryotic organelles.
15. Isolation: Classification of isolating mechanism.

16. Natural Selection: Stabilizing, Directional and Sexual selection.

MODULE V

17. Genetics Variations: Hardy- Weinberg Principle and Genetic drift.
18. Adaptation: Kinds of adaptations.
19. Speciation: Allopatric, Sympatric speciation.
20. Radiation evolution, Horse evolution and Human Evolution.

Suggested Readings:

1. Simpson, G.G. Principles of Animal Taxonomy. Oxford IBH Publishing Company.
2. Mayor, E. Principles of systematic zoology. New York,McGraw-Hill.
3. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valetine. Evolution. Surjeet Publication, Delhi.
4. Futuyama, D.J. Evolutionary Biology. Suinuaer Associates, INC Publishers, Dunderland.
5. Jha, A.P. Genes and Evolution. John Publication, New Delhi
6. Strikberger, M.W. Hall B.K. and Hallgrimson B. Evolution. Jones and Bartlett Publisher, Boston London

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-413

L	S	P	Hrs
4	0	0	4

COURSE NAME: HUMAN PHYSIOLOGY

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Mammalian, principally human, systems physiology, building on knowledge of basic physiological principles established in the course ● Knowledge of some areas in physiology of organisms and to introduce new and more complex physiological functions ● Further practical biological skills introduced in course
Course Outcomes	By the end of the course, students should be able to: ● Classify different types of tissue and explain physiology of skeletal system and joints ● Explain haemopoetic and lymphatic system homeostatic and its altered physiology ● Explain the physiology of cardiovascular and respiratory system and its disorders ● Explain the physiology of digestive,nervous, urinary and reproductive system and its disorders ● Explain the physiology of endocrine system and sense organs and its disorders ● Describe the physiology of muscle contraction and its disorders

MODULE I

1. Internal Transport and Gas Exchange: Systems of circulation.
2. Hemopoiesis and blood clotting.
3. Neural and chemical regulation of respiration.
4. Gas transfer in air and water, Gas exchangers.

MODULE II

5. Acid-base balance, electrolyte balance, blood pressure, blood volume
6. Regulation of water balance, micturition, waste elimination, urine concentration
7. Thermoregulation: Heat balance in animals, Adaptations to temperature extremes
8. The Renin-Angiotensin System

MODULE III

9. Adaptations to Stress: Basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones.

10. Physiology of Deep-Sea Diving, Body Temperature Regulation
11. Endogenous and exogenous biological rhythms.
12. Physiology of Nervous System.

MODULE IV

13. Digestion of various biological molecules (Carbohydrates, Lipids and Proteins).
14. Absorption and assimilation of various biological molecules
15. Muscle physiology: Striated and smooth muscle.
16. Adaptationsofmusclesforvariousactivities,Neuronalcontrolofmusclecontraction

MODULE V

17. Sense organs: Eyes and Ears.
18. Endocrinology: Major Endocrine glands, and their hormone.
19. Hormones and diseases.
20. Neuroendocrine regulation of Hormones, their classification and chemical nature.

Suggested Readings:

1. Ruegg, J.C., Calcium in muscle activation, Springer Verlag Berlin Heidelberg, NewYork.
2. Hoar, W.S. General and comparative physiology, Prentice, Hall Inc./England Wood cliffs, NewJersey.
3. Guyton, A.C. and Hall, J.E.; Text book of medical physiology, 10th Ed, Saunders, Harcourt, India.
4. Heilmeyer, L.M.G. Cellular regulation of protein phosphorylation, springer-verlag, Berlian Heidelberg, New York.
5. Prosser, C.L. and Brown, F.A. comparative Animal Physiology 2nd Ed. W.B. Sunders, Philadelplina.
6. Karpati, G., Jones, D.H. and Griggs. R.C. Disorders of Voluntary Muscle, 7th Edn, Cambridge University Press.
7. Turner, C.D. General Endocrinology, 4th Ed. W.B. Saunders, Philadelphia London.

Members **External Expert** **HoD**

COURSE CODE: ZOO-AEC-414

L	S	P	Hrs
4	0	0	4

COURSE NAME:BIOSTATISTICS, COMPUTER APPLICATION AND BIOINFORMATICS

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Central tendency. ● Tool development that aid in the analysis of such data. ● Recognizing the importance of data collection and its role in determining scope of inference. ● Demonstrating a solid understanding of interval estimation and hypothesis testing. ● Choosing and apply appropriate statistical methods for analyzing one or two variables. ● Using technology to perform descriptive and inferential data analysis for one or two variables. ● Using the keyboard with the touch keyboarding method in this course.
Course Outcomes	By the end of the course, students should be able to: ● Understand the microbial genome applications □ ● Understand the molecular medicine ● Understand the personalized medicine and preventative medicine ● Recognize the definition of statistics, its subject and its relation with the other sciences.

MODULE I

1. Definition and scope of biostatistics.
2. Probability, Discrete and continuous variables.
3. Measures of central tendency: Mean, median, mode.
4. Standard deviation.

MODULE II

5. Analysis of variance,
6. Correlation and regression.
7. Different graphical representation of data.
8. Student's t test, Chi Square test.

MODULE III

9. Introduction of generation of computer andlanguages.
10. Binary Number systems.
11. Application software: MS Word, MS Excel, MS PowerPoint.
12. Introduction to Internet and its Applications in biology.

MODULE IV

13. Definition and scope of bioinformatics.
14. Scoring Matrix.
15. Bioinformatics Software and its Applications.
16. Bioinformatics drug discovery.

MODULE V

17. DNA sequencing.
18. Human genome project.
19. Definition and objectives of proteomics
20. Relationship between gene and protein.

Suggested Readings:

1. Daniel, W.W. Biostatistics: A Foundation for analysis in the Health Sciences.7thEd. John Wiley and Sons, New York.2006.
2. Dunn, O.J. and V.A. Clark. Basic Statistics: A primer for Biomedical Science, John Wiley and Sons, New York. 255 pp.2009.
3. Hunt, R. and J. Shelly. Computer and Common Sense.4th Ed. Prentice Hall, India. 224 pp.2002.
4. Sinha, P.K. Computer Fundamentals. 4th Ed. B.P.B. Publication. 404 pp.2003
5. Primrose,S.B.andTwymanR.M.PrincipleofGenomeAnalysisandGenomics(7th Ed.,2006),Blackwell Publishing Company, Malden, USA
6. Brown, T. A. Genomes 3. Garland Science Publishing, London,UK

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-415 (P)

L	S	P	Hrs
0	0	4	8

COURSE NAME:PRACTICAL-I (based on paper ZOO-CC-411,ZOO-CC-412 and ZOO-CC-413)

Course Objectives	• To acquire practical knowledge of physiological which will help further in research studies. • By doing these practical students will be able to differentiate of different invertebrates. • Knowledge about evolution of horse and man.
Course Outcomes	By the end students will be able to understand the • Biological research with safe lab practices. • Knowledge of different techniques used to study human physiology. • Students be able to recognise the slides and specimen.

1. Counting of RBCs and WBCs in human blood.
2. Determination of hemoglobin percentage in human blood.
3. Detection of blood groups and Rh factor in human blood.
4. Determination of blood clotting time.
5. To prepare hematin crystals.
6. Study of blood pressure and its measurement.
7. Study of Protozoa in Living State.
8. Preparation of permanent Slides of structural parts of invertebrates.
9. Study of museum specimen.
10. Preparation of Phylogenetic tree by using molecular data.
11. Problems related to evolution and population genetics.
12. Study of ancestor of horse and man.
13. Field trip/study
14. Use of keys to identify the different invertebrates of the region.
15. Problems based on lotka-voltera model.

Members **External Expert** **HoD**

COURSE CODE: ZOO-AEC-416 (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-II (based on paper ZOO-AEC-414)

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Recognizing the importance of data collection and its role in determining scope of inference. ● Demonstrating a solid understanding of interval estimation and hypothesis testing. ● Choosing and apply appropriate statistical methods for analyzing one or two variables. ● Using technology to perform descriptive and inferential data analysis for one or two variables. ● Using the keyboard with the touch keyboarding method in this course.
Course Outcomes	By the end of the course, students will be able to: ● Understand the personalized medicine and preventative medicine ● Recognize the definition of statistics, its subject and its relation with the other sciences. ● Will be able to get knowledge about computer that used in their research work.

1. Problems related to chi square test.
2. Problems related to ANOVA.
3. Problems related to standard deviation.
4. Problems related to correlation.
5. Problems related to regression
6. Calculation of central tendency
7. Construction of Excel sheets
8. Construction of Power point presentation.
9. Working in MS word.
10. Conversion of binary number to decimal and vice versa.

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-501

L	S	P	Hrs
0	2	0	2

COURSE NAME: SEMINAR

Course Objectives	• To identify practical learning skills and concepts that will promote students academic success. • To encourage students to explore the connection between university study and life enrichment. • To promote respect for diversity issues and concepts.
Course Outcomes	• Improving communication skills. • Gaining expert knowledge. • Networking with others. • Renewing motivation and confidence.

Members **External Expert** **HoD**

SEMESTER-II

COURSE CODE: ZOO-CC-421

L	S	P	Hrs
4	0	0	4

COURSE NAME: BIOLOGY OF VERTEBRATES

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Vertebrate animals, their taxonomy and anatomy. ● Evolution of morphological and anatomical features of body organs in vertebrate 4 classes. ● Different types of structural modifications which are developed in the different body systems or organs as modes of adaption with the changes in the surrounding environment. ● Samples taken for each taxon as a model of study.
Course Outcomes	By the end of the course, students should be able to: ● Demonstrate an understanding of the characteristics of vertebrates and what makes both chordates and vertebrates unique among animals. ● Demonstrate an understanding of the evolutionary history of vertebrates and the evolutionary relationships among different groups of vertebrates. ● Compare and contrast the many physiological, ecological, and behavioral adaptations of the different groups of vertebrates. ● Compare and contrast the external anatomy, skeletal features, and internal organ systems of the different groups of vertebrates.

MODULE I

1. Origin of Chordata: Concept of Hemichordata, Urochordata and Cephalochordata.
2. Classification of vertebrates.
3. Development, general structure and functions of skin.
4. Glands, scales, horns, claws, nails, hoofs, feathers and hair

MODULE II

5. Form, function, body size and skeletal elements of the body.
6. Comparative account of jaw suspensorium and Vertebral column.
7. Comparative account of limb.
8. Comparative account of girdles.

MODULE III

9. Comparative account of Alimentary canal and Digestive Glands.
10. Comparative account of respiratory organs.
11. Structure and functions of different types of kidney.
12. Comparative account of Urino-genital ducts.

MODULE IV

13. General plan of blood circulation in reptiles, birds and mammals.
14. Evolution of heart.
15. Evolution of aortic arches and portal systems.
16. Comparative account of respiratory organs and spinal cord.

MODULE V

17. Organs of Olfaction and taste.
18. Lateral line system and electroreception
19. Flight adaptations in vertebrates.
20. Aquatic adaptations in birds and mammals.

Suggested Readings:

1. Young, J.Z. Life of Vertebrates. Oxford University Press, London.
2. Young, J.Z. Life of mammals. Oxford University Press, London.
3. Colbert, E.H. Evolution of the Vertebrates. John Wiley and Sons Inc., NewYork.
4. Kent, C.J. Comparative Anatomy of Vertebrates.
5. Walters. H.A. and Sayles. L.D. Biology of Vertebrates. Macmillon and Co., NewYork.
6. Waterman, A.J. Chordata Structure and Function. Macmillon Co., NewYork.
7. Montagna, W. Comparative Anatomy. Clarenden Press, Oxford.

Members **External Expert** **HoD**

Sri Sai University, Palampur

COURSE CODE: ZOO-CC-422

L	S	P	Hrs
4	0	0	4

COURSE NAME: CELL AND MOLECULAR BIOLOGY

Course Objectives	The course objectivesis to provide the students with a basic understanding of: ● Structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles ● Cellularcomponents used to generate and utilize energy in cells ● Cellular components underlying mitotic cell division. ● Cell and molecular biology to selected examples of changes orlosses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation
Course Outcomes	By the end of the course, students should be able to: ● Understand and appreciate the diversity of life as it evolved over time by processes of mutation, selection and genetic change ● Summarize that biological systems grow and change by processes based upon chemical transformation pathways and are governed by the laws of physics. ● Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context.

MODULE I

1. Cell Division: meiosis & mitosis.
2. Control & regulation of cell cycle.
3. Check points: CDK functions, ATM, ATR.
4. Role of cyclins.

MODULE II

5. Basics of organelles.
6. Lipid raft and FRAP.
7. Various types of ion channels, pumps and transporters.
8. Cellular fractionation.

MODULE III

9. Cell Signaling: bacterial chemotaxis, regulation of signaling pathways, second messengers and signal transduction pathways.
10. G-protein couple receptors mediated signaling.
11. Cell surface receptors, hormones & their receptors.
12. Cellular communication: various junctions and communications.

MODULE IV

13. DNA and RNA Replication: Meselson Stahl experiment, prokaryotic and eukaryotic replication.
14. DNA polymerase and their specific function.
15. RNA polymerase and their specific function.
16. DNA Repair.

MODULE V

17. Regulation of gene expression.
18. Protein sorting in mitochondria.
19. Protein sorting in chloroplast.
20. Protein sorting in peroxisomes.

Suggested Readings:

1. Robertis, De and De Robertis. Cell and Molecular Biology. Lea andFebiger.
2. Lodish, Berk, Zipursky, Matsudaira, Baltimore, Darnell. Molecular Cell Biology. W. H. Freeman and Company.
3. Lewin, B. 2000. Genes VII Oxford University, Press, NewYork
4. Alberts,B.Bray,D., Lewis,J.Raff,M.,Roberts,K.andWatson,J.D.1999,Molecularbiologyofthecell. Garland Publishing, Inc. NewYork.
5. Wolfe, S.L. 1993, Gruissem, W. and Jones, R.L. 2000, Biochemistry and molecular biology ofplants, American society of plant physiologists, Maryland,USA
6. Frifelder, D. Molecular Biology. John and Bartlett Publishers, inc., Boston,USA

Members **External Expert** **HoD**

Sri Sai University, Palampur

COURSE CODE: ZOO-CC-423

L	S	P	Hrs
4	0	0	4

COURSE NAME: BIO-TECHNIQUES

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Basic knowledge of microscope. ● SEM and TEM. ● Electrophorosis. ● PAGE ● Cryotechniques ● Chromatography ● Immunological and histological techniques
Course Outcomes	By the end of the course, students should be able to: ● Describe basis of classification of different microscope. ● Describe different immunological and histological techniques ● Describe characteristics and significance of different Biotechniques used in Zoology.

MODULE I

1. Principle and applications of Light microscope,
2. Principle of phase contrast microscope and Fluorescence microscope.
3. General principle and applications of Electron microscope (TEM & SEM).
4. Cryotechniques: Cryopreservation of cells & tissues, freeze fractures and freeze drying.

MODULE II

5. Principles and applications of photometry.
6. Working and application of Colorimeter
7. Working and application of spectrophotometer.
8. Separation techniques: Chromatography, principle, types andapplications.

MODULE III

9. Electrophoresis, principle, types & applications.
10. Difference between PAGE and agarose gelelectrophoresis
11. Principle and application of Autoradiography.
12. Principle of centrifugation.

MODULE IV

13. Techniques: immunofluorescence, immunoelectrophoresis, Hybridoma technology.
14. Immunological techniques: ELISA, RIA.
15. Molecular markers.

16. Histological techniques: Principles of tissue fixation, Microtomy and histochemical staining.

MODULE V

17. Animal cell culture
18. Molecular cytological techniques: In situ hybridization, FISH.
19. Southern hybridization and Northern hybridization, Western blotting.
20. Polymerase chain reaction (PCR) and its types.

Suggested Readings:

1. Freidfelder. Physical Biochemistry. Freeman,1982.
2. Robert Braun. Introduction to instrumental analysis. McGraw Hill Int. Ed.K. Wilson and K. H.
3. Wilson and Walker. Practical Biochemistry. Cambridge,2000.
4. Cooper. The Cell -A Molecular Approach. ASM,1997.

Members **External Expert** **HoD**

Sri Sai University, Palampur

COURSE CODE: ZOO-CC-424

L	S	P	Hrs
4	0	0	4

COURSE NAME: CONCEPTS OF IMMUNOLOGY

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Basic knowledge of immunological processes ● Different fight off infections ● Different types of cells and immune responses
Course Outcomes	By the end of the course, students should be able to: ● Define the basic concepts of the immunology ● Define the various defence mechanisms of human body ● Definevarious autoimmune diseases ● Define various cells and organs involved in immunity

MODULE I

1. Overview of immunology: Components of innate and acquired immunity
2. Haematopoesis; Cells of the immune system
3. Organs of the immune system
4. Systematic functions of the immune system

MODULE II

5. Antigens–immunogens; haptens; nature of antigens;
6. Immunoglobulins-basic structure, classes & subclasses of immunoglobulins,
7. Antigenic determinants; antigen-antibody interactions.
8. Monoclonal and polyclonal antibodies

MODULE III

9. Major Histocompatibility Complex–Immune responsiveness and disease susceptibility
10. B-cell receptor; Immunoglobulin superfamily; B cell maturation, activation and differentiation; Generation of antibody diversity
11. T-cell receptors and T-cell maturation, activation and differentiation; Functional T Cell Subsets
12. Complement system.

MODULE IV

13. Regulation of immune response: Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens
14. Generation of humoral and cell mediated immune responses
15. Cytokines and their role in immune regulation
16. Immunological tolerance

MODULE V

17. Cell mediated cytotoxicity: Mechanism of T cells and NK cell mediated lysis; Antibody dependent cell mediated cytotoxicity; Macrophage mediated cytotoxicity
18. Immunity to Infection: Bacteria, viral, fungal and parasitic infections
19. Hypersensitivity – Type I-IV
20. Autoimmunity- MHC and TCR in autoimmunity.

Suggested Readings:

1. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2005). Kuby Immunology, 5 th Ed., W.H. Freeman and Company, New York.
2. Benjamini, E., Coico, R. and Sunshine, G. (2009). Immunology: A Short Course, 6th Ed., New York, Wiley-Blackwell.
3. Abbas, A.K., Litchman, A.H. (2006-2007). Basic Immunology: Functions and Disorders of the Immune System, 2nd Ed. (updated edition), Philadelphia, Pennsylvania: W.B. Saunders Company Publishers.
4. Roitt, I., Brostoff, J. and Male, D. (2001). Immunology, 7th Ed., Mosby
5. Roit, I.M., Delves, P. Seamus M. and Burton D. (2006). Essential Immunology, 11th Ed., Willey- Blackwell.
6. Kanfmann S.H.E., Sher, A., Ahmed, R. (2002). Immunology of Infections Diseases, ASM Press, Washington.

Members **External Expert** **HoD**

COURSE CODE: ZOO-OE-425

L	S	P	Hrs
2	0	0	2

COURSE NAME: ECONOMIC ZOOLOGY

Objectives	The course objectives is to provide the students with a basic understanding of: ● Basic concept of Apiculture, sericulture and lac culture ● Basics of poultry keeping and knowledge of fish culture ● Pathogenicity of protozoans and Helminthes associated with human diseases ● Detail study of Integrated Pest Management
Course Outcomes	By the end of the course, students should be able to: ● Explain the basics of apiculture, sericulture and lac culture ● Describe poultry keeping and fish culture ● Describe life cycle of protozoans and Helminthes associated with human diseases ● Describe completely Integrated Pest Management.

MODULE I

1. Elementary knowledge of Sericulture.
2. Elementary knowledge Apiculture
3. Elementary knowledge Lac culture

MODULE II

4. Elementary knowledge of Poultry Keeping
5. Elementary Knowledge of Fish culture.
6. Genetic improvements in aquaculture industry.

MODULE III

7. Induced breeding and transportation of fish Seed.
8. Elementary knowledge of Animal Husbandry.
9. Preservation and artificial insemination in cattle.

MODULE IV

10. Parasitic protozoa and human diseases (Life history and pathogenicity of *Plasmodium vivax* and *Trypanosoma gambiense*).
11. Parasitic Helminthes and human diseases (Life history and pathogenicity of *Schistosoma*, and *Wuchereria bancrofti*).
12. Integrated Pest Management (IPM).

MODULE V

13. Life cycle, medical importance and control of Anopheles, Aedes, and

Xenopsyllacheopis.

14. Biology, Control and damage caused by *Helicoverpaarmigera* and *Pyrillaperpusilla*,
15. Safe storage of stored grains.

Suggested reading:

1. Arora and Arora: Medical Parasitology. II Edition. CBS Publications and Distributors.
2. Atwal (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
3. Dunham (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
4. Hafez (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
5. Jabde.: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, agricutural Pests and their Control. Discovery Publishing House.
6. Park: Preventive and Social Medicine. XVI Edition. B.B Publishers.
7. Pedigo (2002). Entomology and Pest Management, Prentice Hall.
8. Ravindranathan: Economic Zoology. Vedant eBook (P) Ltd. New Delhi.
9. Shukla &Upadhyay: Economic Zoology. 4th Ed. Rastogi Publ., Meerut.
10. Sobti: Medical Zoology. Sobhan Lal Nagin Chand & Co. Jallendhar.

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-426 (P)

L	S	P	Hrs
0	0	4	8

COURSE NAME:PRACTICAL-III (based on paper ZOO-CC-421 and ZOO-CC-422)

Course Objectives	• To provide students the opportunity to gain a first-hand laboratory experience of the structure, function, and development of the cell and organisms. • Students will be able to know the difference between anatomical and morphological character of vertebrates. • Students will get the knowledge about different bones.
Course Outcomes	• To develop the scientific attitude that makes the students open minded, critical observations, curiosity thinking etc. • Students will be able to making the slides. • Students will be able to making the slides of different stages of chick.

1. Study of histology of different organs of chick through permanent stained slides.
2. Study of different stages of mitosis and meiosis from permanent slides /charts/photographs.
3. Specimens: morphology and external characters of chordates.
4. Demonstration of dissection of Scolidon through video clippings/models/charts.
5. Demonstration of dissection of frog through video clippings/models/charts.
6. Osteology study of vertebrates.
7. Study of sex chromatin bars bodies from human buccal mucosa.
8. Preparation of temporary slides of meiosis from testis of grasshopper.
9. Projects based upon aquatic adaptation in birds through charts/flex and mammals.
10. Projects based upon aquatic adaptation in mammals through charts/flex.
11. Visit to zoo/national Park/fossil park/geology and anthropology museum.

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-427 (P)

L	S	P	Hrs
0	0	4	8

COURSE NAME:PRACTICAL-IV (based on paper ZOO-CC-423 and ZOO-CC-424)

Course Objectives	• To provide the students with the knowledge about the principles and reactions in immunology. • Students will be get the knowledge about chromatographic technique. • Students will get the basic knowledge about various microscopy.
Course Outcomes	• Students will know the principle and various techniques related to immunology. • Students will be able to making project on biological techniques. • Students will be able to demonstrate the SDS PAGE agrose gel electrophoresis.

1. To study the parts of different microscopy and its maintenance.
2. To separate a sample with the help of chromatographic techniques.
3. General principle and application of SEM.
4. General principle and application of TEM
5. Demonstration of working of Centrifuge.
6. To study different photometric techniques, their principle and working.
7. Demonstration of SDS-PAGE, agrose gel electrophoresis.
8. Demonstration of ELISA through videos/charts.
9. Purification and production of monoclonal antibodies through videos.
10. Antibody interaction with antigen through video.
11. Study working and principle of PCR.
12. Study working and principle of western blotting.
13. Minor Project related to biological techniques.
14. Projects based on autoimmune disease.

Members **External Expert** **HoD**

SEMESTER-III

COURSE CODE: ZOO-CC-431

L	S	P	Hrs
4	0	0	4

COURSE NAME: DEVELOPMENTAL BIOLOGY

Course Objectives	The course Objectives is to provide the students with a basic understanding of: ● How an organism develops—how a single cell becomes an organized grouping of cells that is then programmed at specific times to become specialized for certain tasks. ● Generating cellular diversity and order within each generation, and it ensures the continuity of life from one generation to the next.
Course Outcomes	By the end of the course, students should be able to: ● Provide an introduction to the processes of development and the mechanisms by which they are achieved. The course will integrate, wherever possible, results from different experimental systems (vertebrate and invertebrate animals, plants) and from different experimental approaches (embryology, developmental genetics, cell and molecular biology). ● Develop the skill of observing developing organisms and recording by notes and drawings; to introduce some of the surgical and cellular experimental techniques of developmental biology.

MODULE I

1. Cell commitment, Potency and Specification.
2. Induction and Competence.
3. Morphogenes and Morphogenic Gradient.
4. Morphogenetic gradients and Stem cells.

MODULE II

5. Gametogenesis: Spermatogenesis and Oogenesis.
6. Menestruation and esturation cycle.
7. Zygote formation, Cleavage and Blastula formation.
8. Cell fate.

MODULE III

9. Vulva formation in *C. elegan*.
10. Fertilization and polyspermy in sea urchin.
11. Anterior and posterior axis formation in Drosophila.
12. Tetrapod limb development.

MODULE IV

13. Eye lens formation in vertebrates.
14. Placenta and Placental formation.
15. Regeneration invertebrates.

16. Metamorphosis.

MODULE V

17. Sex determination in various animals.
18. Axis and pattern formation in frog and chick.
19. Fertilization in mammals.
20. Programmed cell death and Ageing.

Suggested Readings:

1. Gilbert, S.F. Developmental Biology. Sinauer Associated Inc., Massachusetts.
2. Ethan Bier. The Cold Spring. The Cold Spring Harbor Laboratory Press, NewYork.
3. Balinsky, B.I. Introduction to Embryology. Saunders, Philedelphia.

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-432

L	S	P	Hrs
4	0	0	4

COURSE NAME: GENETICS

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● How nucleic acids transport genetic information ● Experiments that showed the role of nucleic acids for genetic information ● Identifying the cellular and molecular basis of immune responsiveness. ● Describing the roles of the immune system in both maintaining health and contributing to disease
Course Outcomes	By the end of the course, students should be able to: ● Understandthe chemical basis of heredity ● Understandthegenetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms. ● Understand how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc. ● Understandthe role of genetic mechanisms in evolution. ● Demonstrate the basic knowledge of immunological processes at a cellular and molecular level. define central immunological principles and concepts

MODULE I

1. Mendel's laws and their chromosomal basis.
2. Allelic variation and gene function: incomplete dominance andco-dominance.
3. Multiple allele
4. Lethal alleles.

MODULE II

5. Gene Interaction: Epistasis and Pleiotropy.
6. Genetic linkage and gene mapping
7. Population genetics: Analysis in pedigrees.
8. Cytogenetics: human karyotype, Chromosome banding, ploidy and Chromosome aberration.

MODULE III

9. Quantitative inheritance and tetrad analysis.
10. Genome: complexity, gene, introns, fate, gene families and human nuclear genome.
11. DNA Packaging, histone modification

12. Polytene, lampbrush and B-Chromosomes

MODULE IV

13. Heterochromatin and Euchromatin.
14. Chromosome banding, Sex chromosomes and sex determination
15. Dosage compensation.
16. DNA replication in prokaryotes and eukaryotes at transcriptional and post transcriptional level.

MODULE V

17. DNA recombination and repair.
18. Regulation of gene activity in *lac* and *trp* operons of *E.coli.*
19. Occurrence and causes of gene mutation,
20. Oncogenes- tumor inducing retroviruses.

Suggested Readings:

1. Gardner, E.J., Simmons, M.J. and Snustad, D.P. 1991 (latest ed.). John Wiley and Sons, Inc.
2. Gupta, P.K. 2011. Genetics. Rastogi Publications.
3. Snustad and Simmons. Principles of Genetics, (4th Ed. 2005), John Wiley and Sons, USA.
4. Griffiths, J.F., Gelbart, M., Lewontin, C. and Miller, W. H. Modern Genetic Analysis: Integrating Genes and Genomes, Freeman and Company, New York, USA
5. Kuby. Immunology. W.H. Freeman and Company.
6. W. Pual. Fundamentals of immunology.
7. I.M. Roitt. Essential immunology, ELBS Edition.

Members **External Expert** **HoD**

COURSE CODE: RM-CC-022

L	S	P	Hrs
4	0	0	4

COURSE NAME: RESEARCH METHODOLOGY

Course Objectives	This course will help to: • Develops Better Insight into Topic; • Provides Systematic Structure; Enhance the Research Quality**;** • Derive Better Solutions; Aids In Decision Making; Inculcates Logical and Systematic Thinking
Course Outcomes	At the end of this course, the students should be able to: • understand some basic concepts of research and its methodologies • identify appropriate research topics • select and define appropriate research problem and parameters • prepare a project proposal (to undertake a project) • organize and conduct research (advanced project) in a more appropriate manner • write a research report and thesis • write a research proposal (grants)

MODULE I

1. Foundations of Research**:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory.
2. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process.
3. Problem Identification & Formulation **–** Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis.
4. Hypothesis Testing – Logic & Importance

MODULE II

5. Research Design: Concept and Importance in Research – Features of a good research design.
6. Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses.
7. Experimental Design: Concept of Independent & Dependent variables.
8. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

MODULE III

9. Measurement: Concept of measurement– what is measured? Problems in measurement

in research – Validity and Reliability.

10. Levels of measurement – Nominal, Ordinal, Interval, Ratio.
11. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling.
12. Determining size of the sample – Practical considerations in sampling and sample size.

MODULE IV

13. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages).
14. Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
15. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Chemical Sciences, Impact factor of Journals, When and where to publish ?
16. Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

MODULE V

17. Use of Encyclopedias, Research Guides, Handbook etc.
18. Academic Databases for Computer Science Discipline.
19. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley.
20. Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

Suggested reading:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

Members **External Expert** **HoD**

COURSE CODE: ZOO-OE-433

L	S	P	Hrs
2	0	0	2

COURSE NAME: ECOLOGY

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Ecology, its concept and of different factors govern ecosystem. ● Different types of habitats and their structures ● Ecological modelling and energy transfer with in ecosystem ● Population and its characteristics.
Course Outcomes	By the end of the course, students should be able to: ● Define the basic rules and concepts of the ecology science. ● Define the ecology of individual, population, community and ecosystem. ● Define all biotic and abiotic factors that are related to individual, population, community and ecosystem

MODULE I

1. Definition, concept & scope of Ecology
2. Climatic factors of an ecosystem.
3. Edaphic factors of an ecosystem.

MODULE II

4. Biogeochemical cycles (Carbon, Nitrogen, Sulphur and Phosphorus cycles)
5. Ecosystem: biotic components, Food Chain, Food Web, Productivity, ecological Pyramids.
6. Fundamentals of ecological modelling.

MODULE III

7. Lentic habitat: Structure, Components and Zonation.
8. Lotic Habitat: Structure, Components and Zonation.
9. Marine Habitat: Structure, Components and Zonation.

MODULE IV

10. Estuarine Habitat: Structure, Components and Zonation.
11. Grassland ecosystem: Structure, Components and Zonation.
12. Forest Ecosystem: Types, Structure, Components and Zonation.

MODULE V

13. Ecological succession: Type and Mechanism.
14. Biogeographical zones of India.
15. Population ecology: Characteristics and Growth curves.

Suggested Readings:

1. Chapman, J.L. and M.J. Reiss. Ecology Principles and Applications. Cambridge Univ. Press.
2. Kumar, H.D. Modern Concepts of Ecology. Vikas Publ. House, New Delhi. 293pp.1996.
3. Odum, F.P. Fundamentals of Ecology. 3rd Ed. W.B. Saunders & Co. Philadephia, U.S.A.
4. Cherrett, J.M.: Ecological concept, Blackwell Scientific Publication, Oxford, U.K.
5. Krebs, C.J.: Ecological Methodology, Harper and Row, New York.
6. Krebs, C.J.: Ecology, Harper and Row, New York

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-434

L	S	P	Hrs
4	0	0	4

COURSE NAME: APPLIED ZOOLOGY

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Providing quality education in a branch of Biological sciences i.e Zoology with different specializations. ● Facilitating Higher education & research in zoology. ● Providing quality education offering skill based programs and motivate the students for self employment in applied branches of Zoology.
Course Outcomes	By the end of the course, students should be able to: ● Understand different species of culturable fishes, ornamental fishes, fish culture practices, management of fish culture, fish processing and preservation ● Construct an ornamental fish culture unit for selfemployment ● Understand different honey bee species, bee products, silk worm species, sericulture, earthworm species and related diseases ● Identify diseases of fishes, silk worms and honey bees**.**

MODULE I

1. Apiculture: Introduction
2. Honey bee Life Cycle, Flora for Apiculture.
3. Cultivation and Harvesting Products of Bee keeping and their importance, Honey composition, quality and importance
4. Enemies of Honeybees.

MODULE II

5. Lac culture: Introduction.
6. Species for lac culture, Life cycle and Hostplants.
7. Lac composition, properties & importance Cultivation and Harvesting of Lac.
8. Enemies of Lac insect.

MODULE III

9. Sericulture: Introduction
10. Species, their Life Cycle and hostplants.
11. Silk composition, kinds and uses, Rearing of silkworm and Silk Production
12. Enemies of Silkworm.

MODULE IV

13. Vermiculture: Introduction
14. Species and life cycle, Methods of Vermiculture, Factors affecting vermiculture.
15. Pisciculture: Introduction
16. Species and methods of pisciculture with special reference to H.P.

MODULE V

17. Prawn culture: Introduction.

18. Fresh and Marine Prawn farming.
19. Brief epidemiology of Cholera, Typhus.
20. Brief epidemiology of Malaria and AIDS.

Suggested Reading:

1. Bhamrah,H.S.&Juneja,K.(2001),AnintroductiontoMollusca.AnmolpublicationsPvt,. Ltd.NewDelhi.
2. Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm; Vermiculture and Vermicomposting, Kalyani Publishers India.
3. Carter, G. A. (2004) Beekeeping, Biotech Books, New Delhi.
4. Fenermore, P. G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi.
5. Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
6. Jhingran , V. G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
7. Kumar, A. and Nigam, P. M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
8. Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
9. Mustafa, S. (1990) Applied and Industrial Zoology. Associated Publishing Company, New Delhi.
10. Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
11. Sathe, T. V. and Jadhav, A. D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-435

L	S	P	Hrs
4	0	0	4

COURSE NAME: ANIMAL BEHAVIOR AND WILD LIFE CONSERVATION

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Important concept of animal behavior ● Various methods of behavior study ● Both phylogenetically and physiologically the functional relationships of all factors involved in behavior. ● Theory and practice of wildlife conservation
Course Outcomes	By the end of the course, students should be able to: ● Explain the mechanisms in instinct and behaviour ● Acquire a clear understanding about behavior patterns in animals ● Understand the concept of protected area system ● Detail understanding of conservational approaches and organizations ● Understand the concept of wildlife census techniques

MODULE I

1. Introduction to Animal Behavior and Scope and Importance
2. Instinct and Learned behavior.
3. Neuroanatomical and Neurophysiological techniques of behavior study.
4. Neurochemical and EEG methods of behavior study.

MODULE II

5. Role of Hypothalmus in the modification of behavior
6. Pheromones, their role and functions
7. Biological clocks and its type
8. Orientation: Taxes and Kinesis

MODULE III

9. Social organization in primates.
10. Fish Migration: Gametic, Alimental, climatic and osmoregulatory.
11. Communication: Auditory, Visual, chemical and Tactile.
12. Altruism: reciprocal altruism, group selection, kin selection, cooperation, alarm call.

MODULE IV

13. Wildlife: Definition, significance and Biogeographic/wildlife zones of India.
14. Bio-diversity of the Indian Subcontinent and cause of degradation.
15. Legislation to protect wild life and Environment.
16. Protected Areas of India and Biosphere reserves.

MODULE V

17. Wildlife trade: Ivory trade, Decoration, Medicinal etc.
18. Major Projects to conserve wildlife.
19. Methods for Animal Census.
20. Role of WWF, IUCN, UNEP.

Suggested Readings:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOL-Wattenslip, Pratunam Bangkok, 10400, Thailand
3. Ali, S. Ripley S.D. Handbook of Birds of India, Pakistan 10-Vols. Oxford University Press, BombayPeterMarler and J. Hamilton. Mechanism of Animal Behaviour,; John Wiley & Sons,USA
4. David McFarland. Animal Behaviour, Pitman Publishing Limited, London,UK
5. John Alcock. Animal Behaviour, Sinauer Associate Inc.,USA
6. Wildlife in India by V.B. SahariaNatraj Publishers, Dehradun
7. Reena Mathur. Animal Behaviour. Rastogi Publication, Meerut.

Members **External Expert** **HoD**

COURSE CODE: **ZOO-EC-436**

L	S	P	Hrs
4	0	0	4

COURSE NAME: BASIC ENDOCRINOLOGY

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Classification of hormone and endocrine glands. ● Knowledge of hormone released from endocrine glands. ● Controlling the disease of endocrine glands.
Course Outcomes	By the end of the course, students should be able to understand the : ● Function of different gland. ● How different gland behave in body in different condition i.e. in disease condition. ● Knowledge of different scope of endocrinology.

MODULE I

1. Introduction, objectives and scope of endocrinology - modern concepts and problems in Endocrinology
2. Endocrine glands in crustaceans, insects and vertebrates.
3. Discovery and classification of Hormones.
4. Mechanism of Hormone action. Chemical Messenger.

MODULE II

5. Pituitary gland - characteristics, structural organization - hormone secretion and its functions.
6. Thyroid gland - structural organizations, metabolic effects of thryroid
7. Parathyroid its structure and functions.
8. Anatomy and physiology of the endocrine and neuroendocrine system of Annelida, Arthropoda and Mollusca.

MODULE III

9. Structure of pancreas, pancreatic hormones and their functions.
10. Biochemistry and physiology of insulin and glucagon.
11. General development and comparative anatomy biochemistry and physiology of pineal gland
12. Biochemistry and Physiology of Adrenal glands .Disorder of Adrenal gland.

MODULE IV

13. Concepts of neurosecretions - endocrine systems in crustaceans.
14. Endocrine control of moulting and metamorphosis neuroendocrine system in insects.
15. Hormonal imbalance and major endocrine disease: Gigantism, acromegaly, dwarfism, addison's disease, cushing syndrome. goitre, cryptorchidism, hypogonadism, amenorrhea, Diabetes mellitus, Tetany
16. Prostaglandins types' chemistry mechanism of action and their effects on mammalian

reproduction.

MODULE V

17. Structure of mammalian testis and ovary - male and female sex accessory organs –
18. Hormones of testis and ovary - estrous and menstrual cycle –
19. Hormones of pregnancy - parturition - hormonal control of lactation.
20. Hormonal control of metamorphosis in an anuran amphibian.

Suggested readings:

1. Haris, G.W. and B.T. Donovan. 1968. The Pituitory Gland. S. Chand and Co.,
2. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
3. Mac Hadley. 1992. Endocrinology, 3rd Edition. Prentice - Hall Inc. A Simon &Schuster Company, Englewood Cliffs, New Jersey. USA.
4. Ingleton, P.M. and J.T. Bangara. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
5. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders International Student edition. Toppan Company Limited. Tokyo.
6. Barrington, E.J.W. 1985. An introduction to general and comparative endocrinology. Claredon Press Oxford.

Members **External Expert** **HoD**

COURSE CODE: **ZOO-CC-437(P)**

L	S	P	Hrs
0	0	4	8

COURSE NAME:PRACTICAL-V (based on paper ZOO-CC-431 OR ZOO-CC-432 and RM-CC-022)

Course Objectives	The course Objectives to provide students with a basic understanding of: ● How an organism develops—how a single cell becomes an organized grouping of cells that is then programmed at specific times to become specialized for certain tasks. ● How chick development is occurred.
Course Outcomes	• Develop the skill of observing developing organisms and recording by notes and drawings; to introduce some of the surgical and cellular experimental techniques of developmental biology. • Students will be able to know cleavage and placenta. • Problem based on multiple alleles blood groups.

1. Morphological observation of the 4-14 somite chick embryo (24-34hours) through slides.
2. Morphological observation of the 24-38 somite chick embryo (48-85hours) through slides.
3. Morphological observation of 72 and 96 hours chick embryo.
4. Various patterns of Cleavage through charts/models.
5. Study of different types of eggs and placenta.
6. Study of permanent slides of reproductive organ.
7. Problems based on multiple alleles – Blood groups.
8. Problems based on Mendel's Laws – monohybrid and dihybrid ratios.
9. Problems based on gene frequency – Hardy Weinberg Law.
10. Karyotype studies.
11. Problems based on multiple alleles – Blood groups.
12. Study of different softwares for palagiarism.
13. Reference management softwares.
14. Softwares for paper formatting.
15. Study of various search engines.

Members **External Expert** **HoD**

COURSE CODE: **ZOO-EC-438(A) (P)**

L	S	P	Hrs
0	0	2	4

COURSE NAME: PRACTICAL-VI (based on paper ZOO-EC-434)

Objectives	The course objectives is to provide the students with a basic understanding of: ● Different techniques in applied zoology. ● Areas of research in applied zoology.
Course Outcomes	By the end of the course, students should be able to: ● Explain the basic techniques of apiculture, sericulture and lac culture ● Explain the different diseases of apiculture, sericulture and lac culture ● Explain and identify different fishes of Himachal Pradesh. ● Know about different fisheries institutes of Himachal Pradesh.

1. Study of life cycles of honey bee.
2. Study life cycle of Silkworm.
3. Study life cycle of Lac insect.
4. Study different prawn culture technique.
5. Study of diseases of honey bee
6. Study of diseases of silkworm
7. Study of diseases of lac insect
8. Field report on vermiculture unit
9. To study different fish species in relation to Himachal Pradesh.
10. Visit to various fisheries institute of Himachal Pradesh

Members **External Expert** **HoD**

COURSE CODE: **ZOO-EC-438(B) (P)**

L	S	P	Hrs
0	0	2	4

COURSE NAME: PRACTICAL-VI (based on paper ZOO-EC-435)

Course Objectives	The main objectives of these practicals are students will get: • Practical knowledge of important concept and types of animal behavior • In depth knowledge of Theory and practice of ethology
Course Outcomes	• It will boost students for keen understanding various behavioral activity of animal world • Students will acquire a clear practical understanding about behavior patterns in animals • Students will know about the practical approaches of protected area system in India • Detail understanding of residential and migratory nature of avian fauna

1. To study the geotaxis behaviour of earthworm.
2. To study the median threshold concentration of sucrose solution in eliciting feeding responses of housefly.
3. To study the orientation responses of larvae to volatile stimuli.
4. To demonstrate response of animals to light.
5. To demonstrate antennal grooming behaviour in cockroach.
6. Demonstration of food preferences in insects/pests
7. Geotaxis behavior in snails
8. Study of Migratory Birds
9. To prepare charts of wildlife zones of India and the world
10. Study of morphological changes in common avian species during breeding season
11. Preparation of charts of endangered amphibians, reptiles and mammals with ecological remarks.
12. Study of Diversity indices
13. Study of beaks and claws of different bird species.
14. Field visit to a zoo or wildlife part/sanctuary and preparation of field report

Members **External Expert** **HoD**

COURSE CODE: **ZOO-EC-438(C)(P)**

L	S	P	Hrs
0	0	2	4

COURSE NAME: PRACTICAL-VI (based on paper ZOO-EC-436)

Course Objectives	The main objectives of these practicals are to: • Study about various endocrine glands disease. • Study about effect of epinephrine on blood sugar level and liver glycogen. • Study about hypophysectomy, thyroidectomy and adrenalectomy.
Course Outcomes	After study of this course students will be able to get knowledge about: • Hypophysectomy, thyroidectomy, adrenelectomy • Histological study of various endocrine slides. • Effect of epinephrine on blood sugar level and liver glycogen. • Effect of corticoid on liver.

1. To study various endocrine diseases through models/charts/videos
2. Demonstration through chart or model or video Hypophysectomy in fish.
3. Demonstration through chart or model or video Thyroidectomy in suitable animals (Rat/Mice).
4. Demonstration through chart or model or video Adrenalectomy in suitable animals (Rat/Mice).
5. Histological study of endocrine glands with the help of permanent slides (Lungs, Thyroid, Parathyroid, Pancreas, Pineal, Pituitary glands.)
6. Effect of epinephrine on blood sugar level and liver glycogen of a suitable animals(Demonstration).
7. Effect if corticosoid on the liver glycogen deposition in the rat/mice(Demonstraion).
8. Dissection of rat showing various endocrine glands through chart /video /model
9. Chart/Model showing various hormonal effect during pregnancy.
10. Chart/Model showing various pituitary hormonal effect during menstruation cycle.

Members **External Expert** **HoD**

SEMESTER-IV

COURSE CODE: ZOO-CC-441

L	S	P	Hrs
4	0	0	4

COURSE NAME: BIOCHEMISTRY

Course Objectives	The course objectivesis to provide the students with a basic understanding of: ● Demonstration of knowledge and understanding of the molecular machinery of living cells; ● Demonstration knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition; ● Integrating basic biological and chemical knowledge and its structure to develop a foundation in the concepts and facts in modern cell and molecular biology and biochemistry, and to be familiar with various ways of organizing and accessing scientific knowledge
Course Outcomes	By the end of the course, students should be able to: ● Explain/describe the synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways along with their regulation at the epigenetic, transcriptional, translational, and post-translational levels including RNA and protein folding, modification, and degradation. ● Analyze structural-functional relationships of genes and proteins from bacteria to eukaryotes using genomic methods based on evolutionary relationships.

MODULE I

1. Structure of atoms, molecules and chemical bonds.
2. Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc.).
3. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, and colligative properties).
4. Overview of biomolecules

MODULE II

5. Carbohydrate: classification, occurrence, structure and function of monosaccharides, oligosaccharides.
6. Lipids: classification, occurrence structure and importance of acyl lipids and phoshphates.
7. Amino acids, peptides and proteins. Occurrence, structure and function of amino acids, stereoisomers, transamination,
8. Structure and function of proteins,Conjugate proteins

MODULE III

9. Ramachandran plot
10. Enzymes:classification,modeofactionandenzymekinetics(Michaelis-MentenConstant)
11. Enzyme inhibition
12. Coenzymes, Cofactors and Ribozymes.

MODULE IV

13. Overview of biochemical pathways
14. Glycolysis and Pentose phosphate pathway.
15. Kreb's cycle,
16. Gluconeogenesis and Glycogenesis

MODULE V

17. Nucleic acid bases-their structure and function
18. Electron transport chain and oxidative phosphorylation
19. Biosynthesis and function of purines
20. Biosynthesis and function of pyrimidines

Suggested Readings:

1. Voet, D. and J.G. Voet. Biochemistry. John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry. W.H. Freeman &Co.
3. Segal, I.H. Biochemical Calculations. John Wiley and Sons
4. Creighton, T.E. Protein Structure and Molecular Properties. W.H. Freeman & Co.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-442

L	S	P	Hrs
4	0	0	4

COURSE NAME: ENVIRONMENTAL BIOLOGY-I

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Environmental problems ● What are the different types of Habitat and factors governs them. ● To expose the students in understanding various types of interactions between biotic and abiotic components of environment. ● To describe how the biogeochemistry, energy flow, or biodiversity of ecosystems responds to climate change or another disturbance
Course Outcomes	By the end of the course, students should be able to: ● Explain the need for intra- and interdisciplinary cooperation in researching different ecosystems ● Explain the all biotic and abiotic factors that are related to individual, population, commMODULEy and ecosystem and defines the relationships between them ● Specialized within ecology such as marine, vegetation and statistical ecology provides students information to better understand the environment around them ● Communicate complex environmental information to both technical and non-technical audiences

MODULE I

1. Basic Concepts: Definition, Scope and Significance of Ecology, Concept of biosphere, atmosphere, lithosphere and hydrosphere
2. Ecosystem: Components and Structure.
3. Ecosystem Functions: Productivity, Food Chain, Food web Trophic level and Ecological pyramids
4. Climatic factors of Environment.

MODULE II

5. Edaphic factors of Environment
6. Ecological modeling: Fundamentals of constructing models
7. Biosphere and biogeochemical cycles
8. Basic concept of Limiting factors.

MODULE III

9. Community: Structure and Dynamics.
10. Population: Concept and Characteristics.
11. Population dynamics and r and k selection
12. Ecological succession: Types; mechanisms; changes involved in succession;

concept of climax

MODULE IV

13. Habitat ecology: Fresh water habitat.
14. Habitat ecology: Marine and Estuarine habitat.
15. Habitat ecology: Terrestrial habitat
16. Ecological adaptations in various animals.

MODULE V

17. Species Interaction: Positive and Negative interaction.
18. Biodiversity: Importance and diverse fauna of India.
19. Biodiversity Extinction: Cause and IUCN Red list
20. Principles of conservation, Indian case studies on conservation/management strategy (Project Tiger etc.).

Suggested Readings:

1. Cherrett, J.M. Ecological Concepts. Blackwell Science Publication, Oxford, U.K.
2. Elseth, B.D. and K.M. Baumgartner, Population Biology. Van Nostrand Co., New York.
3. Krebs, C.J. Ecology. Harper & Row, New York.
4. Krebs, C.J. Ecological Methodology. Harper & Row, New York.
5. Eckert, R. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman and Co., New York.
6. Schiemdt Nielsen. Animal Physiology: Adaptation and Environment. Cambridge

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC- 443

L	S	P	Hrs
4	0	0	4

COURSE NAME: ENTOMOLOGY-I

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Basic insect biology, as well as natural history and evolutionary relationships of insect orders and families ● Several aspects of the biology of insect ● Appreciating the impact that insects have (both positive and negative) on human society, including human health, agriculture, and the environment
Course Outcomes	By the end of the course, students should be able to: ● Demonstrate phylogenetic "tree thinking" and be able to categorize insects based on basic ecological, behavioral, morphological, physiological, or developmental attributes. ● To be able to examine insects deeply within a biological level of analysis and compare strategies used by different groups ● Be able to identify the potential impact of different insect species on agriculture, human health, and society in general; to be knowledgeable about potential control strategies

MODULE I

1. Origin and evolution of insects.
2. Insect Society: group of social insects and their social life.
3. Social behavior in honey bee and ants.
4. Social behavior in termites and wasps.

MODULE II

5. Morphology: external features and their articulation.
6. Comparative study of head-antennae, mouth parts; thorax – legs, wings; abdominal appendages, genitalia.
7. Taxonomy: historical development of classification of insect, basis of insect classification.
8. Classification of insects up to sub orders and up to super families in economical important groups.

MODULE III

9. Insect Plant Interaction - Theory of co-evolution.
10. Role of allele-chemicals in host plant mediation, tri-trophic interaction.
11. Host-plant selection by phytophagous insects, establishment of insect population on a plant surface.
12. Forensic Entomology: Introduction, forensically important insects,

collection of data from cadaver site, interpretation of data for predicting time and cause of death.

MODULE IV

13. Structure and physiology of digestive and excretory systems.
14. Structure and physiology of circulatory and respiratory.
15. Structure and physiology of reproductive and nervous system.
16. Sensory receptors. Growth, metamorphosis and diapause in insect.

MODULE V

17. Definition of pesticides, brief history, pesticides registration, pesticide industries and markets.
18. Dose-response relationship; mode of action of insecticide.
19. Group characteristics of insecticide, structure and function of organochlorine, organophosphorus, carbamate, pyrethroid, other plant origin as well as bio-insecticides, neonicotinoids and nitrogenous insecticides, fumigants, IGRs.
20. Metabolism or degradation of pesticides - phase I and phase II reactions. Insecticide resistance and health hazards.

Suggested Reading:

1. Snodgrass, R.E. Principles of Insect Morphology. Tata MacGrawHill, sBombay.
2. Nayar, K.K., T.N. Ananthakrishnan and B.V. David. General and Applied Entomology. Tata MacGraw Hill, NewDelhi
3. Chapman, A.D. and Hall, A generaltext book of entomology,Imms,UK
4. Borror, D. J., Triplehorn, C. A., and Johnson, N. F., Introduction to the study of insects, M Saunders College Publication, USA

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-444

L	S	P	Hrs
4	0	0	4

COURSE NAME: FISH, FISHERIES AND AQUACULTURE-I

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● To acquaint the students about the huge diversity of fishes ● To acquaint about biology of fish and methods of aquaculture, which are important contributors to food security.
Course Outcomes	By the end of the course, students should be able to: ● Learn identification of fish species using classical morphological methods ● Generate knowledge about various methods and significance of aquaculture ● Create awareness about food security, significance of protein in diet and importance of fish in fighting protein deficiency ● Acquainting with methods of conserving fish diversity.

MODULE I

1. Definition of Fish, Fisheries and aquaculture; Types of Aquaculture
2. Classification of fishes with distinguishing characters and examples of each group.
3. Estuarine, Marine, Riverine and wetland fisheries: characteristic species and their exploitation.
4. Culture fisheries: Cultivable organisms for aquaculture; Criteria of selection of cultivable fishes

MODULE II

5. Design, construction and maintenance of fish culture ponds.
6. Ecology of fish pond ecosystem: Physico chemical and biological conditions of ponds water; Weeds and their control; Classification of water bodies on the basis of productivity; productivity of fish pond
7. Aquatic pollution: Sources of water Pollution, Impact of pollution on aquatic organisms, Impact of exotic fish species on aquatic biodiversity
8. Fishes and their relationships with abiotic and biotic factors.

MODULE III

9. Fish integument: Exoskeleton and coloration
10. Fins: origin, types and functions
11. Food and feeding habits of fishes, Digestion in fishes
12. Respiratory system Gill structure and functions, Accessory respiratory organs.

MODULE IV

13. Osmoregulation in fishes
14. Receptors in fishes: Chemoreceptors; Lateral line organs; Eye; Ear
15. Hormones and reproduction: Induced breeding in carps and catfishes.
16. Identification of different maturity stages of fishes.

MODULE V

17. Migration in fishes
18. Age and growth studies
19. Aspects of aquaculture and fisheries with reference to Himachal Pradesh.
20. Role of fishery and aquaculture in human welfare

Suggested reading:

1. Encyclopedia of Fish Physiology. 2011. Anthony P. Farrell, E.D. Stevens, J.J. Cech&J.G. Richards (Eds). Academic Press, UK.
2. APHA (1995) Standard Methods of Examination of Water and Wastewater. American Public Health Association, AWWA, WCPF, Washington DC.
3. Bardach, JE, Ryther&McLarney, Wo (1972) Aquaculture, New York: Wiley-Interscience. 896pp.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-445

L	S	P	Hrs
4	0	0	4

COURSE NAME: ENVIRONMENTAL BIOLOGY-II

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Identifying the environmental problem and to find its solution. ● Restrict and regulate the exploitation and utilization of natural resources. ● Controlling environmental pollution and gradation.
Course Outcomes	By the end of the course, students should be able to: ● Provide definitions of environment, management, systems and organisations in relation to environmental management ● Describe organisations as systems and their role in environmental management ● Understand the usefulness of systems thinking in relation to environmental management in organizations ● Explain how environmental management can be used as environmental protection and how organisations can define and manage risk.

MODULE I

1. Basic concept of Environmental Biology, Scope of Environmental Sciences.
2. Environment Challenges: Challenges confronting India and other developing countries.
3. Sustainable development: Concept and Strategies.
4. Water shed management

MODULE II

5. Natural Resources: Types and cause of degradation.
6. Solid waste management.
7. Cause effect and prevention of Water pollution and Rain water harvesting
8. Type and formation of cloud.

MODULE III

9. Cause effect and prevention of Air pollution.
10. Ozone depletion and Greenhouse effect.
11. Global warming: Cause, Impact of global warming.
12. Cause effect and prevention of land pollution, hermal pollution and Noise pollution.

MODULE IV

13. Disaster management. Cause and effect of flood
14. Energy Resources: Conventional and Nonconventional.
15. Energy Crisis and Solutions.
16. Bioremediation Technology: Need, Merits and Scope.

MODULE V

17. Environmental Impact Assessment

18. International organizations and Conventions for environment.
19. Environmental movements and legislation
20. International conservation bodies: IUCN, UNDP, FAO,WWF.

Suggested Reading:

1. Arora, S. Fundamentals of environmental biology. Kalyani Publishers,1985.
2. Clark L.G. Elements of ecology. Wiley,Newyork.
3. Kormondy, E.J. Concepts of ecology. Prentice –Hall,1969.
4. Smith, T.M. and Smith, R.L. Elements of ecology. Benjamin Cummings Publication.
5. Sharma, P.D. Ecology and Environment. Rastogi Publication, NewDelhi.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-446

L	S	P	Hrs
4	0	0	4

COURSE NAME: ENTOMOLOGY-II

Course Objectives	The course objectives is to provide the students with a basic understanding of: ● Classes of arthropoda, characteristics with examples insect's body exoskeleton (Head, Thorax, Abdomen)and their appendages ● Taxonomy of insects in to different orders such as (Lepidoptera, Hymenoptera, coleoptera, Diptera)and others ,so that students will be able to distinguish varied groups of insects depending upon their morphological characteristics ● Knowing the methods of keeping and preserving insect's specimens ● Function of insect's systems such as digestive ,respiratory and circulation systems ● Different types of metamorphosis.
Course Outcomes	By the end of the course, students should be able to: ● Attain a solid foundation in insect biology, including general entomology, basic systematics, morphology, physiology, and biodiversity. ● Understand evolution and biodiversity generation through macro- and micro-evolutionary processes, including how these processes have formed and diversified insects. ● Develop the ability to design and perform a scientific study on insects, and to analyze results. ● Develop an understanding of the distributions and abundances of organisms including insects, and their interactions with each other and the environment.

MODULE I

1. Introduction to vector biology, economic importance and control of fleas, lice and bugs.
2. Vector biology, economic importance and control of mosquitoes, flies and parasitoids.
3. Insect transmitting bacteria of medical, veterinary and agricultural importance.
4. Insect transmitting viruses of medical, veterinary and agricultural importance.

MODULE II

5. Vector-parasite interaction; host-pathogen interaction.
6. Control of insect vector.
7. Pest: definition and its ecology, pest status, features responsible for evolutionary success of insect species.
8. Population dynamics of pests - agro-ecosystem, phases of population fluctuation.

MODULE III

9. Identification, seasonal history, biology, nature of damage and control measures of pests, of cereals, pulse crops.
10. Identification, seasonal history, biology, nature of damage and control measures of pests of cotton, vegetables and oilseeds.
11. Identification, seasonal history, biology, nature of damage and control measures of pests of fruit crops, sugarcane and stored grains.
12. Locust- different species and phases, phase transition, periodicity, migration, biology and control measures.

MODULE IV

13. Integrated Pest Management: history, different phases of pest control.
14. Quarantine, Physical, Cultural, Chemical and Biological control.
15. Genetic and biotechnological methods of control.
16. Pheromones- production, and their use in pest surveillance and management.

MODULE V

17. Plant resistance to insects: types of resistance, mechanism of resistance.
18. JH Mimics &MH-agonist.
19. Transgenic plants: history, *Bacillus thuriengensis* and its mode of action on insect, different sub species of Bt.
20. Development of Bt plant by recombinant DNA technology, resistance management of Bt-crop, prospective and controversies of *Bt* crop.

Suggested Readings:

1. Smith, K.G.V. Insects and other Arthropods of Medical Importance. London, British Museum.
2. Ross, H.H. A Text book of Entomology. John Wiley and Sons, NewYork.
3. Speight, M. R., Hunter, M. D., and Watt, A. D. Ecology of insects, Wiley-Blackwell, UK
4. Schoonhoven,L.M.,vanLoon,J.A.,andDicke,M.InsectPlantBiology.Publisher OxfordUniversityPress, USA
5. Jolivet, P. Interrelationship between insects and Plants, CRC Press, USA.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-447

L	S	P	Hrs
4	0	0	4

COURSE NAME: FISH, FISHERIES AND AQUACULTURE-II

Course Objectives	The course objectives is to provide the students with a basic understanding: ● To generate knowledge about the recent methods of fish stock improvement and intensive culture techniques of important fin-fish and shell-fish species. ● To develop ability for different type of aquaculture practices.
Course Outcomes	By the end of the course, students should be able to: ● Learn the techniques using biotechnological approach to ● Improve fish stock and will also understand ethics involved in it. ● This core elective paper will help in learning culture techniques of aquatic organisms ● This will help in developing skilled personnel in techniques of improving the fish Stock and yield of aquaculturally important aquatic organisms. ● The study of culture techniques of various aquatic organisms helps in the production of healthy food for human consumption in a sustainable manner and also in employment generation.

MODULE I

1. Introduction to fish biotechnology
2. Selection and hybridization
3. Androgenesis and Gynogenesis – natural and induced
4. Polyploidy techniques

MODULE II

5. Sex reversal and sterility
6. Transgenesis, transgenes and application
7. Cryopreservation of gametes and embryo
8. Fish-by products

MODULE III

9. Fish preservation process
10. Nutritive aspect of fish meat and oil.
11. Culture of important fish species (Major carps, common carps, Chinese carps, cat fish culture and Tilapia culture).
12. Knowledge of important fishes of Himachal Pradesh.

MODULE IV

13. Different systems for aquaculture: pond culture, cage culture, raceway culture.
14. Integrated Aquaculture and waste water aquaculture
15. Pearl Culture
16. Prawn culture-Fresh and brackish wate culture

MODULE V

17. Impact of Aquaculture on Environment
18. Methods of Fishing : Crafts and gear technology
19. Fish diseases and their control
20. Nutrition in aquaculture

Suggested readings:

1. Ponniah, AG, Das, P &Verma SR (Ed.) (1998) Fish Genetics and Biodiversity Conservation. Nature Conservators, Muzaffarnagar, India 474pp.
2. Bardach, JE, Ryther, JH &Mclarnely, OW (1972) Aquaculture. Wiley Interscience
3. Boyd, CE (1988) Water quality management for pond fish culture. Developments in Aquaculture and Fisheries Sciences. I. Elsevier Scientific Publishing Company, Amsterdam.
4. Delince, G (1992) The Ecology of the fish pond system. Kluwer Academic Publishers, Netherlands, 230 pp.
5. Hepher, B (1975) Supplementary feeding in fish culture. In: Nutrition and Production of Fishes. Vol. 3 S. Karger, Basel : 183-198
6. Hoar, WS, Randall, DJ & Donaldson, ME (1983) Fish Physiology. Vol. IXA & IXB. Reproduction. Academic Press, London.
7. Jhingran, VG (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp
8. Tandon, KK & Johal, MS (2006) Age and Growth in Indian Freshwater Fishes.Narendra Publishing House Delhi, 232 pp.
9. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi. 755 pp.

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-448 (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-VII (based on paper ZOO-CC-441)

Course Objectives	• To understand the fundamental chemical principles of biochemistry based techniques and their application in biological science.
Course Outcomes	• Students will develop skills in basic laboratory techniques and understand the principles in Biology. • Able to apply the scientific method to the process of experimentation. • This course will make students able to understand the regulation of chemical reactions in living cells.

1. Qualitative estimation of carbohydrate.
2. Qualitative estimation of proteins
3. Qualitative estimation of lipids
4. Action of salivary amylase on starch
5. Test of albumin in urine
6. Test of sugar in urine
7. Test of ketone bodies in urine
8. Estimation of Urea in Urine sample.
9. Separation of sugar by paperchromatography
10. Detection of amino acid by two dimensional paperchromatography

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-449(i)(A) (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-VIII (Based on ZOO-EC-442)

Course Objectives	• To generate knowledge about the recent methods of water and soil sampling • To expose the students in collection, Handling and analysis of various biological and non -biological samples
Course Outcomes	By studying these practicals students will be able to • Analyze different water samples. • Analyze different soil sample. • Differentiate the community structure. • Handle the biological and non-biological sample

1. To determine the pH of given water and soil samples by electrometric method.
2. To determine the EC of given water and soil samples.
3. To determine the TDS of given water and soil samples.
4. To study the various sampling techniques used to collect water samples.
5. To study the various sampling techniques used to collect soil samples
6. Collection, Handling and identification of various biological samples.
7. To determine the light penetration (Transparency) in various water bodies.
8. To determine the Bulk density of given soil samples.
9. To determine the specific gravity of given soil samples.
10. To determine the moisture content of given soil samples.
11. To determine the water holding capacity of different soil sample.
12. To determine the texture of given soil sample.
13. To study and identify the benthic community structure of different fresh water ecosystem.
14. Study of microscopic communities of aquatic ecosystem.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-449(i)(B) (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-VIII (Based on ZOO-EC-443)

Course Objectives	The course objectives to provide students with a basic understanding of: • Apiculture practices. Sericulture practices. • To study the external feature of insects. • To study the digestive system of insects. • To study the detailed classification of class insecta. • Comparative study of insect antennae.
Course Outcomes	By the end of the course, students should be able to: • Impact of Chemical pesticides on insect behavior. • Study of various types of biological techniques to various control pest. • Preparation of permanent slides of insect's mouth and leg parts. • Study various type of SOI.

1. Apiculture practices.
2. Sericulture practices.
3. To study the external feature of insects.
4. To study the digestive system of insects.
5. To study the detailed classification of class insecta.
6. Comparative study of insect antennae.
7. Study of dosages level i.e. LD50 and LC50.
8. Impact of Chemical pesticides on insect behavior.
9. Study of various types of biological techniques to various control pest.
10. Preparation of permanent slides of insects mouth and leg parts.
11. Study various type of SOI.

Members **External Expert** **HoD**

C**OURSE CODE: ZOO-EC-449(i)(C) (P)**

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-VIII (Based on ZOO-EC-444)

Course Objectives	• To generate knowledge about fish structure and function • To apprise students about different zoo and phytoplankton
Course Outcomes	• This will develop students capable of differentiating fishes of Himachal Pradesh and gears for conducting small projects. • Help students to aware of weeds and planktons

1. Study of Anatomy and Morphology of important group of fishes.
2. Taxonomic study of common families, genera and species of fishes
3. Survey and Collection of fishes of Himachal Pradesh.
4. Examination of skeleton of cartilaginous and bony fishes
5. Study of histological and microscopic structure in fishes
6. Analysis of physical and chemical properties of water: Temperature, pH, turbidity, salinity, total solids, Dissolved oxygen, Free carbon-di-oxide, hardness, chlorides, orthophosphates, nitrates, ammonia
7. Qualitative and quantitative examination of Phyto and zooplanktons in a water body.
8. Determination of percent composition of different groups of phyto and zoo planktons
9. Study of Aquatic weeds and aquatic insects
10. Visit to different fisheries stations in Himachal Pradesh and prepare a report.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-449(ii)(A) (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-IX (Based on ZOO-EC-445)

Course Objectives	• To generate knowledge about physical and chemical properties of water and soil • To apprise students about quantitative and qualitative estimation and identification of plankton.
Course Outcomes	By studying these practicals students will be able to: • Analyse the various chemical parameters of water samples • Calculate the productivity of fresh water bodies • Analyse the various chemical parameters of soil samples

1. To determine the dissolved oxygen in given water samples.
2. To determine the free carbon dioxide in given water samples.
3. To determine the Alkalinity of given water and soil samples.
4. To determine the Total Carbon dioxide of given water samples.
5. To determine the Chloride content in given water and soil samples.
6. To determine the sulphate in given water and soil samples.
7. To determine the Hydrogen sulphide content in given water samples.
8. To determine the Total Hardness of given water samples.
9. To determine the Calcium content of given water samples.
10. To determine the Calcium Hardness in given water samples.
11. To determine the Magnesium content in given water samples.
12. Calculate Productivity of given aquatic ecosystem.
13. Qualitative identification of various organisms.
14. Quantitative estimation of organisms.

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-449(ii)(B) (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-IX (Based on ZOO-EC-446)

Course Objectives	The course objectives to provide students with a basic understanding of: • Identification marks and taxonomic status of Insect pest of crop and Vegetables. • Identification marks and taxonomic status of Insect pest of stored grain and fruits. • Identification marks and taxonomic status of Insect pest of stored cotton, sugarcane and pest of cereals
Course Outcomes	By the end of the course, students should be able to understand: • Systematics position up to family and ecology of veterinary pest. • Systematics position up to family and ecology of medical pest. • Vector biology of mosquito. • Vector biology of bugs and fleas.

1. Identification marks and taxonomic status of Insect pest of crop and Vegetables.
2. Identification marks and taxonomic status of Insect pest of stored grain and fruits.
3. Identification marks and taxonomic status of Insect pest of stored cotton and sugarcane.
4. Identification marks and taxonomic status of Insect pest of cereals.
5. Systematics position up to family and ecology of veterinary pest.
6. Systematics position up to family and ecology of medical pest.
7. Vector biology of mosquito.
8. Vector biology of bugs.
9. Vector biology of fleas.
10. To study the insect vector control

Members **External Expert** **HoD**

COURSE CODE: ZOO-EC-449(ii)(C) (P)

L	S	P	Hrs
0	0	2	4

COURSE NAME:PRACTICAL-IX (Based on ZOO-EC-447)

Course Objectives	• To generate knowledge about different fish formulations and identification of different stages of fish growth.
Course Outcomes	• This will develop students to analyze fish feed and formulations. • Help students to aware about gears and other methods of fishery.

1. Fish Feed formulation and processing.
2. Proximate analysis of fish feed (Determination of moisture, protein, fat, ash carbohydrate, fiber and energy).
3. Taking out of pituitary gland, preservation and preparation of extract.
4. Study of benthic macroinvertebrates in natural water bodies.
5. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of Himachal Pradesh.
6. Determination of length weight relationship.
7. Determination of age of fish using hard parts
8. Analysis of fecundity, Gonadosomatic index (GSI), Hepatosomatic index (HIS) in some fishes.
9. Study of crafts and gear and method of operation (Models can also be used)
10. Visit to fish farm and fish market and preparation of report

Members **External Expert** **HoD**

COURSE CODE: ZOO-CC-502

L	S	P	Hrs
0	0	6	6

COURSE NAME:PROJECT

Course Objectives	The objectives of project are to • Students will get opportunities to design research project. • Students will get opportunities to perform experiment on Nobel research. • Students will get opportunities to write dissertation and read out various research paper to frame their research work as well as methodology.
Course Outcomes	• Students will be able to analyse their research result. • They will be able to write research paper. • Students will learn various research related techniques

Overall project dissertation may be evaluated under the following heads:

- Motivation for the choice of topic
- Project dissertation design
- Methodology and Content depth
- Results and Discussion
- Future Scope & References
- Application of Research technique in Data collection
- Presentation style
- Viva-voce

Each student has to submit two copies of the dissertation work duly forwarded by the HOD of Department concerned. The forwarded copies will be submitted in the Department of Zoology, Sri Sai University, Palampur, for evaluation

NB: Students will select topics for the project work in consultation with a teacher of the department. The Seminar will be held in the Department of Zoology, Sri Sai University, Palampur

Members **External Expert** **HoD**