

# PROGRAMME GUIDE

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## MASTER OF SCIENCE (M.Sc.) ZOOLOGY

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\*Scheme of Examination (CBCS/ELECTIVE)

\*Detailed Structure of Syllabus



**DR. C.V.RAMAN UNIVERSITY**  
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Deputy Registrar (Academic)  
Dr. C.V. Raman University  
Kota, Bilaspur (C.G.)

**MASTER OF SCIENCE (ZOOLOGY)**  
 Duration: 24 Months (2Years)  
 Eligibility: Graduation with Science Subjects

COURSE STRUCTURE M.SC ZOOLOGY SEMESTER 1st													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional ***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group													
6SMZO101	Core Course	Biosystematics, Taxonomy and Evolution	100	50	17	20	08	30	12	4	-	-	4
6SMZO102	Core Course	Structure and function of Invertebrates	100	50	17	20	08	30	12	4	-	-	4
6SMZO103	Core Course	Quantitative biology, Biodiversity and Wild Life	100	50	17	20	08	30	12	4	-	-	4
6SMZO104	Core Course	Bimolecular and Structural Biology	100	50	17	20	08	30	12	4	-	-	4
Practical Group				Term End Practical Exam		Lab Performance		Sessional					
6SMZO105	Practical	LAB 1	50	25	08	-	-	25	08	-	-	2	2
6SMZO106	Practical	LAB 2	50	25	08	-	-	25	08	-	-	2	2
	Grand Total		500							16	-	4	20

Minimum Passing Marks are equivalent to Grade D

L- Lectures T- Tutorials P- Practical

Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage - Attendance 50%, Three Class Tests/ Lab Performance Assignment 50%

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Eligibility: Graduation with Science Subjects

COURSE STRUCTURE M.SC ZOOLOGY SEMESTER IInd														
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits	
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional ***		L	T	P	Subject wise Distribution	
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks					
Theory Group														
6SMZO201	Core Course	General and Comparative animal Physiology and Endocrinology	100	50	17	20	08	30	12	4	-	-	4	
6SMZO202	Core Course	Population Ecology and Environmental physiology	100	50	17	20	08	30	12	4	-	-	4	
6SMZO203	Core Course	Tools and Techniques for Biology	100	50	17	20	08	30	12	4	-	-	4	
6SMZO204	Core Course	Molecular cell biology and Genetics	100	50	17	20	08	30	12	4	-	-	4	
Practical Group				Term End Practical Exam		Lab Performance		Sessional						
6SMZO205	Practical	LAB 1	50	25	08	-	-	25	08	-	-	2	2	
6SMZO206	Practical	LAB 2	50	25	08	-	-	25	08	-	-	2	2	
Skill Courses								Sessional						
	Skill Enhancement	Skill EnhancementElective Course-1	50	-	-	-	-	50	20	1	-	1	2	
	Grand Total		550							17		5	22	

Minimum Passing Marks are equivalent to Grade D

L- Lectures T- Tutorials P- Practical

Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage - Attendance 50%, Three Class Tests/Lab Performance Assignment 50%

Skill Elective I - Any other course being offered in this semester as per the list given at the end of course structure.

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COURSE STRUCTURE M.SC ZOOLOGY SEMESTER IIIrd													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group													
6SMZO301	Core Course	Comparative Anatomy ofVertebrates	100	50	17	20	08	30	12	4	-	-	4
6SMZO302	Core Course	Limnology	100	50	17	20	08	30	12	4	-	-	4
****	Discipline Specific Elective	Elective –I (Select any one below given)	100	50	17	20	08	30	12	4	-	-	4
****	Discipline Specific Elective	Elective –II (Select any one below given)	100	50	17	20	08	30	12	4	-	-	4
Practical Group				Term End Practical Exam		Lab Performance		Sessional					
6SMZO305	Practical	LAB 1	50	25	08	-	-	25	08	-	-	2	2
6SMZO306	Practical	LAB 2	50	25	08	-	-	25	08	-	-	2	2
Skill Courses								Sessional					
	Skill Enhancement	Skill EnhancementElective Course-1	50	-	-	-	-	50	20	1	-	1	2
	Grand Total		550							17	-	5	22

Minimum Passing Marks are equivalent to Grade D

Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage - Attendance 50%, Three Class Tests/ Lab Performance Assignment 50%

Skill Elective I - Any other course being offered in this semester as per the list given at the end of course structure.

L- Lectures T- Tutorials P- Practical

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# MASTER OF SCIENCE (ZOOLOGY)

Duration: 24 Months (2Years)

Eligibility: Graduation with Science Subjects

COURSE STRUCTURE M.SC ZOOLOGY SEMESTER IVth													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional ***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group													
****	Discipline Specific Elective	Elective –III (Select any one below given)	100	50	17	20	08	30	12	4	-	-	4
****	Discipline Specific Elective	Elective –IV (Select any one below given)	100	50	17	20	08	30	12	4	-	-	4
Practical Group				Term End Practical Exam		Lab Performance		Sessional					
6SMZO405	Practical	LAB-I	50	25	08	-	-	25	08	-	-	2	2
6SMZO406	Practical	LAB-II	50	25	08	-	-	25	08	-	-	2	2
	Research Component	Project/Internship/Field work & Viva Voce	200	100	33	-	-	100	40	-	-	8	8
	Grand Total		500							8	-	12	20

Minimum Passing Marks are equivalent to Grade D

L- Lectures T- Tutorials P- Practical

Major- Term End Theory / Practical Exam

Minor- Pre University Test

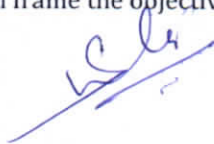
Sessional weightage – Attendance 50%, Three Class Tests/ Lab Performance Assignment 50%

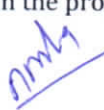
Compulsory Project/Dissertation with choice in any Disciplinary specific elective. Compulsory one paper presentation certificate in related discipline.

## PROJECT

All the candidates of M.Sc. (Zoology) are required to submit a project-report based on the work done by him/her during the project period. A detailed Viva shall be conducted by an external examiner based on the project report. Students are advised to see the detailed project related guidelines on the website of RNTU. ([www.rntu.ac.in](http://www.rntu.ac.in)) under Project Guidelines for student section.

**Outcome-**The student will identify a problem on which he/she would be able to work, identify the scope of research on the chosen topic and will frame the objectives to be addressed in the project through a w




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## SPECILIZATION WITH ELECTIVE

**\*Note** - Students need to select any one group and choose any two subjects from selected group for third and fourth semester.

Electives for Third Semester			Electives for Fourth Semester		
Course Code	Course Type	List of Electives	Course Code	Course Type	List of Electives
<b>GROUP ELECTIVE -I Name - Zoology</b>			<b>GROUP ELECTIVE -III Name -Zoology</b>		
6SMZO303	Discipline Specific Elective-1	Ecotoxicology	6SMZO401	Discipline Specific Elective-3	Fish Structure and Function
6SMZO304	Discipline Specific Elective-1	Animal Behavior and Neurophysiology	6SMZO402	Discipline Specific Elective-3	Wild Life Conservation
6SMZO305	Discipline Specific Elective-1	Animal Experimentation Ethics & Testing	6SMZO403	Discipline Specific Elective-3	Entomology
<b>GROUP ELECTIVE -II NAME: Zoology</b>			<b>GROUP ELECTIVE -I V Name - Zoology</b>		
6SMZO306	Discipline Specific Elective-2	Aquaculture	6SMZO404	Discipline Specific Elective-4	Pisci Culture and Economic Importance of Fishes
6SMZO307	Discipline Specific Elective-2	Gamete Biology Development and Differentiation in Vertebrates	6SMZO405	Discipline Specific Elective-4	Environment & Biodiversity Conservation
6SMZO308	Discipline Specific Elective-2	IPR and GLP	6SMZO406	Discipline Specific Elective-4	Applied Entomology







  
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## SKILL ENHANCEMENT ELECTIVE COURSES

Non-Technical			
Elective No.	Department/ Faculty Name		
	Faculty of Information Technology		
I	SCIT 201	Data Entry Operation	2(1+0+1)
II	SCIT 301	Multimedia	2(1+0+1)
III	SCIT 501	Web Designing with HTML	2(1+0+1)
IV	SCMIT 201	Web Development	2(1+0+1)
V	SCMIT 301	LINUX	2(1+0+1)
	Faculty of Management		
I	SMGT 201	Briefing and Presentation Skills	2(1+0+1)
II	SMGT 301	Resolving Conflicts and Negotiation Skills	2(1+0+1)
III	SMGT 802	Entrepreneurship Development	2(1+0+1)
	Faculty of Commerce		
I	SCOM 201	Tally ERP 9	2(1+0+1)
II	SCOM 302	Multimedia	2(1+0+1)
III	SCOM 803	Data Analyst	2(1+0+1)
	Faculty of Humanities		
I	SHBA 301	Pursuing Happiness	2(1+0+1)
II	SHBA302	Communication Skill and Personality Development	2(1+0+1)
III	SHMA301	Tourism in M.P	2(1+0+1)
	Faculty of Science		
I	SSBI 301	Mushroom Cultivation	2(1+0+1)
II	SSPH 301	House Hold Wiring	2(1+0+1)
III	SSPH 301	Basic Instrumentation	2(1+0+1)
IV	SSPH 301	DTP Operator	2(1+0+1)
V	SSCH 301	Graphic Designing	2(1+0+1)
	Faculty of Education		
I	SCBE 403	Understanding of ICTC (Information Communication Technology)	2(1+0+1)
II	SCPE 201	Yoga Education	2(1+0+1)

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**COURSE OBJECTIVE:-**

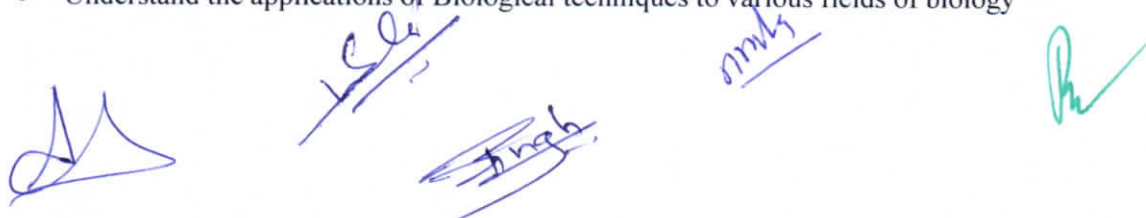
- The primary objective of the program is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students. The Department is having the following objectives:
- To provide quality education in a branch of Biological sciences i.e Zoology with different specializations.
- To facilitate Higher education & research in zoology.
- To provide quality education offering skill based programs and motivate the students for self employment in applied branches of Zoology.
- To Inculcate the spirit of resource conservation and love for nature
- To conduct field studies and different projects of local and global interests.
- To provides opportunities for professional and personal development through curricular and co- curricular activities.
- Provide consultancy and organize extension activities.

**Programme Outcomes (M.Sc. Zoology)**

- The programme also works across related majors within the M.Sc zoology
- Distinguish between the Structure, Function, Behaviour and evolution of different animals
- For instance if you major in zoology, you can also still take courses from across the other complementary.
- Master of Science majors of conservation biology and ecology, giving you an in-depth knowledge of those most closely related programmes
- Apply the wide range of subject based skills to various fields that provide a base for future career in disciplines such as Health Sciences, Agriculture, Environmental Management, Biotechnology, Publishing, Teaching and Research
- Perform, Assess and implement practical techniques and procedure to solve biological problems and analyse and quantify data collected during any project.
- Understand the applications of Biological techniques to various fields of biology.
- When you graduate with a Master of Science (Zoology) you will have learned how to work at a high level of academic achievement.
- Work to deadlines under pressure and communicate effectively.

**Program Specific Outcomes (M.Sc. Zoology)**

- Understand Nature, environment natural resources and their conservation, Classification & Behaviour of different animals, Human genetics, Cytology and Evolution.
- Apply the wide range of subject based skills to various fields that provide a base for future career in disciplines such as Health Sciences, Agriculture, Environmental Management, Biotechnology, Publishing, Teaching and Research.
- Distinguish between the Structure, Function, Behaviour and evolution of different animals.
- Perform, Assess and implement practical techniques and procedure to solve biological problems and analyse and quantify data collected during any project.
- Understand the applications of Biological techniques to various fields of biology



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**SEMESTER- 1<sup>st</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: BIOSYSTEMATICS, TAXONOMY AND EVOLUTION**

**COURSE OBJECTIVE:**

This paper is aimed to introducing the students for the salient features of Taxonomy and Evolution.

**Subject Code: 6SMZ0101**

**Theory Max. Marks:50**

**Theory Min. Marks:17**

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Definition and basic concepts of biosystematics taxonomy and classification,. History of Classification, Trends in biosystematics: Chemotaxonomy cytotoxicity and molecular taxonomy, Dimensions of speciation and taxonomic characters, Species concepts: species category, different species concepts, subspecies and other infra-specific categories. Theories of biological classification: hierarchy of categories.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Taxonomic Character- Different kinds. Origin of reproductive isolation, biological mechanism of genetic incompatibility. Taxonomic procedures: Taxonomic collections , preservation curation, process of identification. Taxonomic keys, different types of keys, their merits and demerits. International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Taxonomic categories. Evaluation of biodiversity indices. Evaluation of Shannon . Weiner Index. Evaluation of Dominance Index. Similarity and Dissimilarity Index.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Concepts of evolution and theories of organic evolution. Neo Darwinism and population genetics: A- Hardy-Weinberg law of genetic equilibrium. B. A detailed account of destabilizing forces: i- Natural selection, ii- Mutation iii- Genetic Drift iv- Migration v- Meiotic Drive. Trends in Evolution Molecular Evolution a) Gene evolution b) Evolution of gene families c) Assessment of molecular variation.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Origin of higher categories Phylogenetic gradualism and punctuated equilibrium. Major trends in the origin of higher categories. Micro and macro evolution. Molecular population genetics Pattern of changes in nucleotide and amino acid sequence. Ecological significance of molecular variations (genetic polymorphism) Genetic & Speciation Phylogenetic and biological concept of species. Patterns and mechanism of reproductive isolation. Modes of speciation (allopatry & sympatry) Origin and Evolution & Economically important microbes and animals.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Classify animals on the basis of their relation to other animals by body structure, external characters, development and DNA.
- Apply the International rules of Nomenclature to give a scientific name to animals which are found during research.
- Understand the gradual development and evolutionary history of different kinds of living organisms from earlier forms over several generations.
- Understand and demonstrate the internal anatomy of various animals, biodiversity and related indices.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Zoo Management	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Taxonomist

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**SEMESTER- 1<sup>st</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: STRUCTURE & FUNCTION OF INVERTEBRATES**

**Subject Code: 6SMZO102**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to introducing the students for structure & function of Invertebrate.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Origin of metazoa Organization of Coelom – Acoelomates, Pseudo coelomates, Coelomates. Locomotion- Amoeboid, Flageller and Ciliary movement in protozoa, Hydrostatic movements in Coelenterata, Annelida and Echinodermata	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Nutrition and Digestion, Patterns of Feeding and digestion in lower metazoa, Mollusca, Echinodermata, Filter feeding in polychaeta. Respiration- Organs of respiration : Gills, lungs and trachea, Respiratory pigments. Mechanism of respiration.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Excretion in lower invertebrates. Excretion in higher invertebrates. Mechanism of Osmoregulation.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Nervous Systema. Primitive Nervous systems:-Coelentrata and Echinodermata. b. Advanced nervous system :- Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	1. Invertebrate larval forms and their evolutionary significance a. Trematoda and Cestoda b. Larval forms of Crustacea c. Larval forms of Mollusca d. Larval forms of Echinodermata. 2. Structure affinities and life history of the following minor Phyla a. Rotifera b. Entoprocta c. Phoronida d. Ectoprocta	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Understand the structure and organization of invertebrate animals.
- Explain modifications in various functions of animals during transition from invertebrates to vertebrates.
- Discuss the evolutionary significance of larval forms of invertebrates.
- Identify invertebrates and homology, analogy and modifications of mouthparts in relation to feeding habits.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Zoo Managment	Goal 04(Quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Taxonomist

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**SEMESTER- 1<sup>st</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: QUANTITATIVE BIOLOGY, BIODIVERSITY AND WILDLIFE**

**Subject Code: 6SMZO103**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to Quantitative Biology, Biodiversity and Wildlife.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Quantitative biology, Distribution of the data in biology- mean, mode and median, Measures of dispersion : range, mean deviation, IQD , standard deviation and coefficient of variation, Chi square test, Normal distribution, Experimental designing and sample theory.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Probability distribution, properties and probability theory, Completely randomized design and randomized block design, Analysis of variance, Co-relation- types of correlation, Karl Pearson, coefficient correlation, Regression.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Biodiversity - concept and principal of biodiversity, causes for the loss of biodiversity. Biodiversity conservation methods , Medicinal uses of forest plant.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Wildlife of India, types of wildlife - Values of wildlife, positive and negative, Wildlife protection Act, Conservation of wildlife in India, Endangered and threatened species.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Wildlife and conservation - National Parks and Sanctuaries, Project Tiger, Project Gir Lion and Crocodile breeding project, Wildlife in M.P. with references to Reptiles Birds and mammals, Biospheres reserves.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- To understand quantitative approaches and technologies involved in research.
- To identify diversity of fauna on earth and implement conservation measures to save diversity
- To understand importance of wildlife and conservation measures, National parks and Sanctuaries.
- Analyse biological data mathematically and statistically

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Taxonomist, Scientist, Academician, Wildlife	Analyst, Wildlife Management, Biodiversity	Goal 04(Quality Education) Goal 14( Life below water) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Wildlife Activist

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**SEMESTER- 1<sup>st</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: BIMOLECULAR AND STRUCTURAL BIOLOGY**

**Subject Code: 6SMZ0104**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to introduce molecular biology viz Amino acid, DNA, RNA and Enzyme.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	<b>Chemical Foundation of biology</b> - pH, pK, acids bases, buffers, weak bonds. Free energy, resonance, isomerisation. Acid soluble pool of living tissues, amino acids, monosaccharides, oligosaccharides, nucleotides, peptides. Nanoparticles Biomaterials	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-II</b>	Primary, Secondary, tertiary and quaternary structures of proteins, protein folding and denaturation; DNA & RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression; DNA replication, recombination and repair; Functional importance of lipid storage and membrane lipids Membrane channels and pumps.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-III</b>	<b>Basic concepts of metabolism:</b> Coupled and interconnecting reactions of metabolism cellular energy recourses and ATP synthesis; Glycolysis and Gluconeogenesis; Citric acid cycle; Oxidative phosphorylation: Protein and its regulation; Fatty acid metabolism: Synthesis and degradation of fatty acids	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-IV</b>	<b>RNA synthesis and splicing;</b> Biosynthesis of amino acids; Biosynthesis of nucleotides; Biosynthesis of membrane lipids and steroids; Protein synthesis	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-V</b>	<b>Enzymes:</b> Terminologies, classification and basics of enzyme kinetics; Mechanism of enzyme catalysis; Regulation of enzyme reaction; Concept of free energy and thermodynamic principals in biology; Energy rich bonds, compound and biological energy transducers.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope

**COURSE OUTCOMES:**

- To explain Biomaterial, Nanoparticles and their importance.
- To understand biological reactions, structure of protein, carbohydrates fats, nucleic acids and their metabolism.
- To develop a knowledge of enzymes and mechanism of their action in various biological reactions.
- To understand the process of gene expression & protein synthesis.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Enzymologist, Protiomics	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Enzymologist

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**SEMESTER- 1<sup>st</sup>**  
**Course: M. Sc. Zoology**  
**SUBJECT:**

**Subject Code: 6SMZ0105**  
**Practical Max. Marks:25**  
**Practical Min. Marks:8**

**PRACTICAL:- (Paper I & II) Lab-I**

- Study of Invertebrate museum specimen & study of their taxonomic character.
- Study of Invertebrate slide & identify their structure.
- Identify the nervous system of different invertebrates: (a) Pila (b) Sepia (c) Prawn (d) Earthworm.
- Determination of O<sub>2</sub> Consumption in insect (Respiration)
- Limnological study of pond water.
- Study the larval forms of crustacean.
- Study of polytene chromosomes in chironomid larva & drosophila larva.
- Aristotle lantern in echinus
- Histological study by microtomy.
- Genetic experiment by checker board (mendel law).

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Taxonomist, Scientist, Academician,	Zoo Management	Goal 04 (quality Education) Goal 15 (Life on Land) Goal 03 (Good health & well being)	Academician, Taxonomist

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**SEMESTER- 1<sup>st</sup>**  
**Course: M. Sc. Zoology**  
**SUBJECT:**

**Subject Code: 6SMZ0106**  
**Practical Max. Marks:25**  
**Practical Min. Marks:8**

**PRACTICAL:- (Paper III & IV) Lab-II**

- Calculate the standard deviation in given gastropods shells.
- Determination of PH value in different solution.
- Preparation of buffers
- Qualitative test for carbohydrate, protein, lipid.
- Separation of amino acid & sugar using paper chromatography.
- Experiment on determination of dissolved oxygen in water.
- To determine the turbidity of given water sample.
- To determine dissolved solids of a given water sample.
- To determine biological oxygen demand (BOD) of given sample of water.
- Study of Phytoplankton and Zooplanktons in pond ecosystem.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Taxonomist,Scientist, Academician,	Enzymologist, Protiomics	Achieved Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician,Enzymologist

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**SEMESTER- 2<sup>nd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: GENERAL AND COMPARATIVE ANIMAL  
PHYSIOLOGY AND ENDOCRINOLOGY**

**Subject Code: 6SMZO201**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to introducing the students for comparative Animal Physiology & Endocrinology

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Respiratory pigments through different phylogenic groups; Transport of oxygen and carbon dioxide in blood and body fluids; Regulation of respiration; Physiology of impulse transmission through nerves and synapses; Autonomic nervous system, neurotransmitters and their physiological functions	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Patterns of nitrogen excretion in different animal groups; Comparative physiology of digestion; Osmoregulation in different animal groups; Thermoregulation in homeotherms, poikilotherms and hibernation; Physiology of pregnancy, placental hormones, pregnancy diagnosis tests, parturition and breast and lactation	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Comparative study of mechanoreception; Comparative study of photoreception; Comparative study of phonoreception; Comparative study of chemoreception; Comparative study of equilibrium reception.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Bioluminescence as means of communication among animals; Pheromones and other similar chemicals as means of communication among animals; Chromatophores and regulation of their function among animals; Hormones, their classification and chemical nature; Mechanisms of hormone action	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Phylogeny of endocrine glands (pituitary, pancreas, adrenal, thyroid); Ontogeny of endocrine glands; Neuroendocrine system; Hormone receptors. signal transduction mechanisms; Hormones and reproduction - a. Seasonal breeders, b. Continuous breeders.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Understand all physiological processes of vertebrates & analyse them biochemically
- Correlate the comparative physiology of the systems and understand their regulation & control
- Compare the structure, functions and regulation of the receptor organs of vertebrates
- Understand the structure, function and regulation of endocrine & neuroendocrine glands,

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Zoo Management	Achieved Goal 04 (quality Education) Goal 15 (Life on Land) Goal 03 (Good health & well being)	Academician, Taxonomist

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**SEMESTER- 2<sup>nd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: POPULATION ECOLOGY AND ENVIRONMENTAL PHYSIOLOGY**

**Subject Code: 6SMZ0202**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to introducing the students for Population Ecology & Environmental Physiology

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Populations and their characters; Demography: Life tables, generation time, reproductive value. Population growth: Growth of organisms with non-overlapping generations, stochastic and time lag models of population growth, stable age distribution. Population regulation: Extrinsic and intrinsic mechanisms.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Adaptations: Levels of adaptations, significance of body size. Aquatic environments: Fresh water, marine, shores and estuarine environments. Eco-physiological adaptations to fresh water environments. Eco-physiological adaptations to marine environments; Ecophysiological adaptations to terrestrial environments.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Environmental limiting factors; Inter and intra-specific relationship; Predatory- prey relationship, predator dynamics, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time); Mutulism, evolution of plant pollinator interaction.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Environmental pollution and human health. Conservation management of natural resources; Environmental impact assessment. Sustainable development.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Concept of homeostasis; Endothermic and physiological mechanism of regulation of the body temperature; Physiological response to oxygen deficient stress; Physiological response to body exercise; Meditation, yoga and their effects.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Understand population and its characters and regulation.
- Correlate physiological adaptations to environment and pollution, control measures for environmental degradation as well as risk factors to human health.
- Understand limiting factors, predator-prey relationships and physiological responses of the body to environment.
- Demonstrate the methods of relaxation of Stress and body by Yoga, Meditation, Asana & Pranayam

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Demographic analysis	Goal 04 (quality Education) Goal 14 (Life below water) Goal 15 (Life on Land) Goal 03 (Good health & well being)	Academician, Demographic analysis

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**SEMESTER- 2<sup>nd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: TOOLS AND TECHNIQUES IN BIOLOGY**

**Subject Code: 6SMZ0203**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to Tools & techniques in Biology.

Units	Unit Wise Course Content	Methodology Adopted
Unit-I	Microscopy, principle & applications - Light microscope and phase contrast microscope, Fluorescence microscope, Electron microscope; Confocal microscopy. General Principle and applications of – Colorimeter, Spectrophotometer, Ultra centrifuge, Flame photometer, Beer and Lambert's law. Microbiological technique- Media Preparation and sterilization, Inoculation and growth monitoring, Microbial assays. Microbial identification (cytological staining methods for bacterial and fungal strains) Use of fermentors.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-II	Computer aided techniques for data presentation data analysis, statistical techniques. Cryotechniques - Cryopreservation of cells, tissues, organs and organism, Cryosurgery, Cryotomy, Freeze fracture and freeze drying; Separation techniques- Chromatography, principle type and applicants. Electrophoresis, Principles, types and applications PAGE and a garose gel electrophoresis. Organelle separation by centrifugation.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-III	Radioisotope and main isotope techniques in biology- a. Sample preparation for radioactive counting, b. Autoradiography. Immunological techniques- Immunodiffusion (Single & Double), Immuno electrophoresis. Techniques- immune detection, Immunocyto/histochemistry Immunoblotting, immune detection, immune fluorescence. Surgical techniques- Organ ablation (eg. Ovariectomy, adrenalectomy), Perfusion techniques, Stereotaxy Indwelling catheters Biosensors.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-IV	Histological techniques- Principles of tissue fixation, Microtomy, Staining, Mounting Histochemistry Cell culture techniques- Design and functioning of tissue culture laboratory, Culture media, essential components and Preparation Cell viability testing.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-V	Cytological techniques- Mitotic and meiotic chromosome preparations from insects and vertebrates- Chromosome banding techniques (G.C.Q. R. banding), Flowcytometry. Molecular cytological techniques- In site hybridization (radio labelled and non-radio labelled methods) FISH, Restriction banding, Molecular biology techniques - Southern hybridizat, Northern hybridization, DNA Sequencing, Polymerase chain reaction (PCR).	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Explain Microscopy, Colorimetry, Chromatography principle, process, applications and working of related instruments.
- Demonstrate Microbiological, Cytological, Histological, Molecular biological techniques.
- Apply and demonstrate Immunological Surgical Immunodetection and Cell culture techniques.
- Understand Cryopreservation, Radioisotope and Isotope techniques and applications of all the techniques in biology.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Immunologist, Histologist, Animal Biotechnologist	Goal 04 (quality Education) Goal 15 (Life on Land) Goal 03 (Good health & well being)	Academician, Toxicologist, Histopathologist





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SEMESTER- 2<sup>nd</sup>

Course: M. Sc. Zoology

SUBJECT: MOLECULAR CELL BIOLOGY AND GENETICS

Subject Code: 6SMZ0204

Theory Max. Marks: 50

Theory Min. Marks: 17

## COURSE OBJECTIVE:

This paper is aimed to introduce molecular cell Biology viz Amino acid, DNA, RNA, protein and Enzyme

Units	Unit Wise Course Content	Methodology Adopted
Unit-I	Biomembrane- Molecular composition arrangement and functional consequences, Transport across cell membrane diffusion active transport, pumps uniports, symports and antiports, Micro filaments and microtubules structure and dynamics, Cell movements intracellular transport, role of kinesis and dynein	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-II	Cell Cell signaling- Cell surface receptors, Second messenger system, Signaling from plasma membrane to nucleus, Gap junctions and connexius, Integrins	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-III	Cell. Cell adhesion and communication - Ca <sup>++</sup> dependanthomophilic cell. Cell adhension, Ca <sup>++</sup> independanthomophilic cell. celladhension, Gap junctions and connexius, Genome organization, hierarchy in organization, Chromosomal organization of genes and non-coding DNA.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-IV	Sex determination - Sex determination in Drosophila, Sex determination in mammals, Basic concept of dosage compensation, Cytogenetic of human chromosomes, Human genome project (HGP) purpose 2 implicate	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-V	Genetic Diseases and Genomics - Human gene therapy, Prenatal diagnosis & genetic counseling, Genetic screening, Structural Genomics, Functional Genomics, Gene libraries, Transgenic animals & their applications.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

## COURSE OUTCOMES:

- Explain Biomembranes and the processes of Cell-cell signalling and cell-cell adhesion.
- Understand the process of Sex determination and details of Human chromosomes & Human chromosome project.
- Understand gene libraries, Transgenic and Knockout animals.
- Understand various genetic processes and their applications to biological systems

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician,	Enzymologist, Protiomics	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Genomics

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**SEMESTER- 2<sup>nd</sup>**  
**Course: M. Sc. Zoology**  
**SUBJECT:**

**Subject Code: 6SMZ0205**  
**Practical Max. Marks:25**  
**Practical Min. Marks:8**

**PRACTICAL:**

**Laboratory -I**

**Determination of blood group of own blood.**

- WBC counting of given blood sample.
- RBC counting of given blood sample.
- Study of grassland ecosystem (Ecology).
- Ecological adaptation in different animal.
- Study the fresh water ecosystem.

Job opportunity	Employability skill	Local/National/UNDP Achieved	Goal	Enterprenurship Opportunity
Taxonomist,Scientist, Academician,	Demographic analysit	Goal 04(quality Education) Goal14(Life below water) Goal 15(Life on Land) Goal 03(Good health &well being)		Academician, Demographic analysit

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SEMESTER- 2<sup>nd</sup>

Course: M. Sc. Zoology

SUBJECT:

Subject Code: 6SMZ0206

Practical Max. Marks: 25

Practical Min. Marks:8

### Laboratory -II

#### Separation of bimolecular by centrifugation.

- Determine the gram negative bacteria & gram positive bacteria.
- Colorimeter estimation.
- Study of microscopy (Light & electron)
- Separation of amino acid & sugar using paper chromatography.
- Electrophoresis.
- Beer and lambert's law
- Microtomy
- Polymarase chain reaction (PCR)
- Phase contrast microscope.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Taxonomist,Scientist, Academician,	Immunologist, Histologist,Animal Biotechnologist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Histopathologist Toxicologist,

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**SEMESTER- 3<sup>rd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: COMPARATIVE ANATOMY OF VERTEBRATES**

**Subject Code: 6SMZO 301**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to introducing the students for the salient features of Comparative anatomy of all Vertebrates.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Origin of Chordata: Concept of Protochordata Development, structure and functions of integument and its derivatives (glands, scales, feathers and hairs), Respiratory system: Characters of respiratory tissue, external and internal respiration. Comparative account of respiratory organs. Comparative account of Digestive System.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Evolution of heart, Evolution of aortic arches and portal systems. Blood circulation in various vertebrates groups. Comparative account of jaw suspensorium and vertebral column.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Evolution of urinogenital system in vertebrates. Comparative account of organs of olfactory and taste. Comparative anatomy of brain and spinal cord (CNS). Comparative account of peripheral and autonomous nervous system.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Comparative account of lateral line system. Comparative account of electroreception. Flight adaptations in vertebrates. Aquatic adaptations in birds and mammals.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Origin, evolution general organization and affinities of Ostracoderms. General organization, specialized, generalized and degenerated characters of Cyclostomes. Origin, evolution general organization of early Gnathostomes. General account of Elasmobranchi, Holocephali, Dipnoi and Crossoptergii.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Knowledge of Origin, Evolution and general organisation of Chordates.
- Knowledge of Evolution of heart, lungs and urino-genital organs of vertebrates
- Knowledge of comparative anatomy of all systems of vertebrates.
- Knowledge of flight and aquatic adaptations in birds and mammals.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician,	Endocrinologist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Scientist, Animal Testing

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KARGI ROAD, KOTA, BILASPUR (C.G.)

SEMESTER- 3<sup>rd</sup>

Course: M. Sc. Zoology

SUBJECT: LIMNOLOGY

Subject Code: 6SMZO 302

Theory Max. Marks:50

Theory Min. Marks:17

### COURSE OBJECTIVE:

This paper is aimed to introducing the students for morphometric analysis and Zonation

Units	Unit Wise Course Content	Methodology Adopted
Unit-I	Limnology – Definition, historical development and scope of Limnology. Types of freshwater habitats and their ecosystem - (a) Ponds, Streams and rivers. (b) Lakes – Origin and classification. Morphometry – Use of various morphometric parameters and Zonation.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
Unit-II	Physico – Chemical Characteristics- Light and Temperature- (a) Light as an ecological parameter in freshwater. (b) Temperature- Radiation, Stratification and Heat Budget, Dissolved Solids – Carbonate, Bicarbonates, Phosphate and Nitrate. Physico – Chemical characteristics of freshwater with special reference to different parameters-Turbidity, dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
Unit-III	Study of Biota- (a) Phytoplankton, Zooplankton and their inter-relationship. (b) Aquatic insects, birds and their environmental significance. Ecological classification of aquatic fauna higher aquatic plants and their significance.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
Unit-IV	Methods of water quality testing BOD and COD, Sewage – Definition, composition and its treatment. Bioindicators- Aquatic flora and fauna in relation to water quality in an aquatic environment	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
Unit-V	Causes of pollution of Aquatic Resources, their management and conservation. Resource Conservation – Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs. Use and misuse of inland water	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope

### COURSE OUTCOMES:

- Knowledge of morphometry, physico-chemical and biological characteristics of fresh water bodies.
- An understanding of the significance of aquatic flora, fauna, insects, birds and macrophytes in water bodies.
- Knowledge of pollution of rivers, causes and control measures.
- Knowledge of legislation and regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Zoo Management	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Taxonomist

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**SEMESTER- 3<sup>rd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: ECOTOXICOLOGY**

**Subject Code: 6SMZO303**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is aimed to awareness of Toxicant, heavy metal toxicity and environmental pollution and ecological impact assessment

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	General principles of Environmental Biology with emphasis on ecosystems. Abiotic and biotic factors of ecosystems. Communities of the environment, their structure & significance. Energy flow in environment: Ecological energetic.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Productivity, Production and analysis. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation. Remote sensing –basic concepts and applications of remote sensing techniques in environmental conservation. Environmental indicators and their role in environmental balance.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Kinds of environmental pollution and their control method. Radioactive compounds and their impact on the environment. Vehicular exhaust pollution causes and remedies. Noise pollution.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Toxicology- Basic concepts, Principles and various types of toxicological agents. Toxicity testing principles, hazards, risks and their control methods. Food toxicants and their control methods. Public Health Hazards due to environmental disasters.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Pesticides, types, nature and their effects on environment. Important heavy metals and their role in environment. Agrochemical use and misuse, alternatives. Occupational Health Hazards and their Control.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- To develop an understanding of environmental biology, productivity and pollution.
- To develop knowledge of Toxicity of foods, pesticides and agrochemicals among youngsters.
- To know public health hazards due to natural disasters and occupation..
- To know the process of recycling and reuse technologies of solid and liquid waste.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician, Toxicologist	Toxicologist, Pharmaccutical drug testing .	Goal 04(quality Education) Goal 14(Life below water) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Toxicologist, Scientist

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**SEMESTER- 3<sup>rd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-I**

**ANIMAL BEHAVIOR AND NEUROPHYSIOLOGY**

**Subject Code: 6SMZO304**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

From this paper introduced about the animal behavior and its neurophysiology.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	1. Introduction: <ul style="list-style-type: none"> <li>- Ethology as a branch of biology.</li> <li>- Animal psychology, classification of behavioral patterns, analysis of behavior (ethogram)</li> </ul> 2. Reflexes and complex behavior.           3. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual.           4. Evolution and ultimate causation: Inheritance behavior and relationships.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	1. Neural and hormonal control of behavior.           2. Genetic and environmental components in the development of behavior.           3. Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation.           4. Communication: Chemical, visual, light and audio, evolution of language (primates).	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	1. Ecological aspects of behavior: Habitat selection, food selection, optimal foraging theory, anti- predator defenses, aggression, homing territoriality, dispersal, host parasite relations.           2. Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.           3. Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	1. Reproductive behavior. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care.           2. Social behavior. aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	1. Thermoregulation: Homoeothermic animals, poikilotherms & Hibernation.           2. Receptor physiology a comparative study - Mechano receptor Photo receptor Phono receptor           3. Chemo receptor Equilibrium receptor Bioluminescence	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Understand neurophysiology of perception memory, domestic animal and human behaviour.
- Analyse processes at different levels and neurophysiology of sensory processing of animal behaviour.
- Classify behavioral patterns, communication, learning and memory.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Scientist, Academician,	Physiologist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist, Physiologist

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SEMESTER- 3<sup>rd</sup>

Course: M. Sc. Zoology

SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-I

ANIMAL EXPERIMENTATION ETHICS & TESTING

Subject Code: 6SMZ0305

Theory Max. Marks:50

Theory Min. Marks:17

### COURSE OBJECTIVE:

M.Sc.student are exposed to a variety of advanced methods and principles which they could employ in research.

Units	Unit Wise Course Content	Methodology Adopted
Unit-I	Animal Experimentation Ethics CPCSEA guidelines , Institutional Animal Ethical Committee (IAEC) , Institutional Bio-Safety Committee (IBSC ), Experimentation on Animals in vivo & in vitro, Animal Handling and Animal ethics .	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-II	Animal House Building and location of animal house, Maintenance of animals, Experimental Area, Environment, Animal Husbandry, Sanitation & Cleanliness, Record keeping, Safety and biohazards	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-III	Animal Testing Toxicity testing and heavy metal toxicity in animal model , Pharmacological testing in animal model , Hematological and Biochemical Analysis , Histopathological Analysis, Receptor mechanism , Types of cell culture ,Animal cell culture & Applications of cell culture , Aseptic technique and Preparation of media , Insect cell culture , Animal Behavior and Physiology , Cognition.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-IV	Microscopy and Image Analysis Techniques Bright field; Fluorescence; Confocal , Phase contrast microscope , Electron Microscope , Image Acquisition and Analysis Microscopy and Image analysis.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
Unit-V	Analytical Techniques and Instrumentation Colorimetry, Spectrophotometry , Centrifugation Chromatography, HPLC , Electrophoresis, Atomic absorption , Immunological Techniques , Radio-immunoassay (RIA) & IRMA.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

### COURSE OUTCOMES:

The goal is to impart Student the knowledge and skills which are contemporary and useful to them. The student will write the standard operating protocols (SOPs) and identify requirement for equipment and reagents.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician,	Histopathologist, Endocrinologist, Animal house maintainer	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Scientist

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**SEMESTER- 3<sup>rd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-II**  
**AQUACULTURE**

**Subject Code: 6SMZ0306**

**Theory Max. Marks: 50**

**Theory Min. Marks:17**

**COURSE OBJECTIVE:**

This paper is aimed to introduce Prawn, Fish, Frog, Pearl Culture, Apiculture, Lac –Culture and Sericulture.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Aquaculture: history, definition, scope & importance. Fishery resources of India in general & Madhya Pradesh in particular. A biotic & biotic factors of water necessary for fish life. Ecological characteristics of lakes & rivers. General ecological characteristics of reservoirs of India.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	Fish culture :- Mono, Poly, mixed and composite Fish culture. Fresh water prawn culture and its prospects in India. Culture of Mussels, clams, oysters & pearl culture. Sewage fed fish culture, paddy cum fish culture.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	Fish breeding in natural conditions, bundh breeding, hypophysation & stripping. Transport of live fish & seed. Different types of crafts & gears used for fish catching. Plankton- its definition, culture & identification. Common weeds of fish ponds and methods of their eradication.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	Fresh water fish farm engineering: selection of site, construction of fish farm & soil chemistry. Designing, layout & construction of different types of fish ponds. Setting and management of fresh water aquarium. Preservation & processing of fish. By products of fish Industry & their utility.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	Water pollution, its effects on fisheries and methods of its abatement. Common fish diseases & their control. Biochemical composition and nutritional value of fish. Fisheries economics and Marketing. Fisheries managements and extension.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Develop a knowledge of farming of aquatic organisms for increasing food production and animals beneficial to human.
- Observe culture techniques, farm management and hatchery operations.
- Analyse harvesting and marketing strategies.
- Understand the technique of fish preservation and Water quality monitoring techniques.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician, Fishery Industry	Fisheries Managment	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Industry, Scientist Fish

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**SEMESTER- 3<sup>rd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-II**

**GAMETE BIOLOGY DEVELOPMENT AND DIFFERENTIATION IN VERTEBRATES**

**Subject Code: 6SMZ0307**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

In this paper the student introduced about the morphology of sperm and ovum or its chemic composition etc

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	1. Comparative account of differentiation of gonads in mammals. 2. Spermatogenesis : Morphological basis in rodents. Gamete specific gene expression and genomics 3. Biochemistry of Semen : Semen composition and formation, assessment of sperm function. 4. Fertilization: Prefertilization events Biochemistry of fertilization post fertilization events.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	1. Ovarian follicular growth and differentiation: morphology, endocrinology, molecular biology oogenesis and vitellogenesis, ovulation and ovum transport in mammals 2. Biology of sex determination and sex differentiation a comparative account. 3. Multiple ovulation and embryo transfer technology : in vitro oocyte maturation, super ovulation.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	1. Hormonal regulation of ovulation, pregnancy and parturition. 2. Hormonal regulation of development of mammary gland and lactation. 3. Endocrinology and Physiology of placenta. 4. Cryopreservation of gametes and Embryo. 5. Teratological effects of xenobiotics on gametes.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	1. Cell commitment and differentiation. 2. Germ cell determinants and germ cell migration. 3. Development of gonads. 4. Melanogenesis.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	1. Creating new cell types, the basic evolutionary mystery. 2. Cell diversification in early Amphibian embryo, totipotency and pluripotency. 3. Embryonic stem cells, renewal by stem cells, epidermis. 4. Connective tissue cell family 5. Haemopoietic stem cells : Blood cells formation, stem cell disorders.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Understand reproductive physiology and development in mammals
- Develop a deep knowledge of the role of endocrine secretion in regulation of reproductive cycle
- Understand the process of differentiation of eggs and sperms before fertilization.
- Develop a knowledge of cryopreservation technique and stem cell disorders.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Scientist, Academician,	Reproductive Scientist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist Reproductive Scientist

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**SEMESTER- 3<sup>rd</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-II**  
**IPR AND GLP**

**Subject Code: 6SMZ0308**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

M.Sc. student are exposed to a variety of advanced methods and principles which they could employ in research.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	Intellectual Property Right (IPR) Legislative initiatives, Patents Act, Designs Act Trademark Act, Geographical indications of Goods.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-II</b>	International Cooperation for improving IP administration WIPO, EU-India Technology and investment development Programme, Indian Registered Geographical Indications.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-III</b>	Good Laboratory Practice Basic concept of GLP, Standard operational procedure (SOP), Working in Laboratory, Sterilization technique, Various routes of injections and sample collection, Safety and biohazards, Record Keeping.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-IV</b>	Analytical Techniques and Instrumentation Immunological Techniques, Radio-immunoassay (RIA) & IRMA, Colorimetry, Spectrophotometry, Centrifugation Chromatography, HPLC, Electrophoresis, Atomic absorption.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
<b>Unit-V</b>	Laboratory Design Toxicology, Pharmacology, Immunology, Zoology, Botany, Microbiology, Biotechnology, Animal cell culture and Plant cell culture.	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope

**COURSE OUTCOMES:**

The goal is to impart student the knowledge and skills which are contemporary and useful to them. The student will write the standard operating protocols (SOPs) and identify requirement

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician, Patents Activist	Lab. Management, SOP	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Scientist

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**SEMESTER- 3<sup>rd</sup>**  
**Course: M. Sc. Zoology**  
**SUBJECT:**

**Subject Code:**  
**Practical Max. Marks:25**  
**Practical Min. Marks:8**

**PRACTICAL**

For equipment and reagents.

**Laboratory -II**

- Animal House : Building and location of animal house, Maintenance of animals.
- Experimental Area, Record keeping, Safety and biohazards.
- Animal Testing: Toxicity testing and heavy metal toxicity in animal model.
- Pharmacological testing in animal model .
- Haematological and Biochemical Analysis
- Histopathological Analysis,

**IPR and GLP**

- Good Laboratory Practice: Basic concept of GLP
- Standard operational procedure (SOP), Safety and biohazards, Record Keeping.
- Working in Laboratory, Sterilization technique , Various routes of injections and sample collection .
- Laboratory Design: Toxicology, Pharmacology, Immunology, Zoology, Botany, Microbiology, Biotechnology.
- Animal cell culture Laboratory

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician,	Histopathologist, Endocrinologist, Animal house maintainer	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist

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**SEMESTER- 3<sup>rd</sup>**  
**Course: M. Sc. Zoology**  
**SUBJECT:**

**Subject Code:**  
**Practical Max. Marks: 25**  
**Practical Min. Marks: 8**

**PRACTICAL:-**

**Laboratory –I**

- Study of different vertebrate museum specimen.
- Study of different vertebrate slide.
- Study of different scales in fishes.
- Prepare a permanent slide of placoid scale.
- Study of different cranial nerves in elasmobranch fishes.
- Electric organ in torpedo.
- Study of abiotic and biotic factor of grassland (in UTD Campus)
- Study of lateral line in elasmobranch fish.
- Study of histological slide (Prepare by microtomy)
- Productivity in grassland ecosystem.

**PRACTICAL:-**

**Laboratory -II**

- Identification of different teleost fishes.
- Internal ear in elasmobranch fishes.
- Afferent & efferent branchial arteries (Aortic arches)
- Morphometric study of different teleost fishes (fin formula fin ray)
- Cranial nerves in teleost fishes.
- Study of phytoplankton & zooplankton in fresh water ecosystem.
- Study of aquarium.
- Identify the common fish disease.
- Common weeds of fish pond & method of their eradication.
- Paedology of fresh water pond necessary for fish life.

Job opportunity	Employability skill	Local/National/UNDP Achieved	Goal	Enterprenurship Opportunity
Taxonomist, Scientist, Academician,	Histopathologist, Taxonomist	Goal 04 (quality Education) Goal 15 (Life on Land) Goal 03 (Good health & well being)		Academician, Taxonomist

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**SEMESTER- 4<sup>th</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-III**  
**FISH STRUCTURE AND FUNCTION**

**Subject Code: 6SMZO401**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This paper is introduced about origin and evolution of fish, Fish structure And Function

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	1. Origin and evolution of fishes 2. Classification of fishes as proposed by Berg 3. Fish integument 4. Locomotion	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	1. Alimentary canal and digestion 2. Accessory respiratory organs 3. Air bladder and its functions 4. Weberian ossicles their homologies and functions	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	1. Excretion and osmoregulation 2. Acoustico-lateral line system 3. Luminous organs 4. Colouration in fishes	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	1. Sound producing organs 2. Deep sea adaptations 3. Hill stream adaptations 4. migration in fishes	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	1. Sexual cycle and fecundity 2. parental care in fishes 3. Early development and hatching 4. Poisonous and venomous fishes.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

- Know the functional anatomy of all organ systems of fish
- Understand migration and adaptations in fishes.
- Observe the phenomenon of Parental care in various fishes and importance of electric organs in fishes.
- Understand the significance of Colouration, luminous and poisonous organs of fish.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician,	Fishery Managment	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist, Fish-Industry

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**SEMESTER- 4<sup>th</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-III**  
**WILD LIFE CONSERVATION**

**Subject Code: 6SMZO402**

**Theory Max. Marks: 50**

**Theory Min. Marks:17**

**COURSE OBJECTIVE:**

From this paper are study about the values of wild life, its habitat & management also.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	<ol style="list-style-type: none"> <li>Wild life -               <ol style="list-style-type: none"> <li>Values of wild life - positive and negative.</li> <li>Our conservation ethics.</li> <li>Importance of conservation.</li> <li>Causes of depletion.</li> <li>World conservation strategies.</li> </ol> </li> <li>Habitat analysis, Evaluation and management of wild life.               <ol style="list-style-type: none"> <li>Physical parameters - Topography, Geology, Soil and water.</li> <li>Biological Parameters - food, cover, forage, browse and cover estimation.</li> <li>Standard evaluation procedures - remote sensing and GIS.</li> </ol> </li> <li>Management of habitats -               <ol style="list-style-type: none"> <li>Setting back succession.</li> <li>Grazing logging.</li> <li>Mechanical treatment.</li> <li>Advancing the successional process.</li> <li>Cover construction.</li> <li>Preservation of general genetic diversity.</li> </ol> </li> </ol>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	<ol style="list-style-type: none"> <li>Population estimation.               <ol style="list-style-type: none"> <li>Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation.</li> <li>Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.</li> </ol> </li> <li>National Organization.               <ol style="list-style-type: none"> <li>Indian board of wild life.</li> <li>Bombay Natural History Society.</li> <li>Voluntary organization involed in wild life conservation.</li> </ol> </li> <li>Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.</li> </ol>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	<ol style="list-style-type: none"> <li>Management planning of wild life in protected areas.</li> <li>Estimation of carrying capacity.</li> <li>Eco tourism / wild life tourism in forests.</li> <li>Concept of climax persistence.</li> <li>Ecology of perturbence.</li> </ol>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	<ol style="list-style-type: none"> <li>Management of excess population &amp; translocation.</li> <li>Bio- telemetry.</li> <li>Care of injured and diseased animal.</li> <li>Quarantine.</li> <li>Common diseases of wild animal.</li> </ol>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope



<b>Unit-V</b>	<ol style="list-style-type: none"> <li>1. Protected areas National parks &amp; sanctuaries, Community reserve.</li> <li>2. Important features of protected areas in India.</li> <li>3. Tiger conservation - Tiger reserve in M.P, in India.</li> <li>4. Management challenges in Tiger reserve.</li> </ol>	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope

**COURSE OUTCOMES:**

- Student able to wild life -Values of wild life, positive and negative.Our conservation ethics, Importance of conservation. Causes of depletion.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters , biological , parameters and standard evaluation procedures.
- National parks & sanctuaries
- Wild life Legislation - its amendments and implementation.
- To the study of management planning of wild life in protected areas.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician, Wildlife Educator	Wildlife Activist Zoo Managment	Goal 04(quality Education) Goal14(Life below water) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist







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**SEMESTER- 4<sup>th</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-III  
ENTOMOLOGY**

**Subject Code: 6SMZO403**

**Theory Max. Marks: 50**

**Theory Min. Marks : 17**

**COURSE OBJECTIVE:**

- To introduce the morphology of typical insect
- To study the general anatomy and physiology of insects.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	1. Insect head types and modification as per their habit and habitat 2. Modification of mouth parts and feeding behavior 3. Structure types and function of antennae 4. Hypothetical wing venation	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	1. Structure of cuticle and pigment 2. Sclerotisation and tanning of the cuticle 3. Structure of alimentary canal and Physiology of digestion 4. Malpighian tubules – anatomical organization , Transport	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	1. Structure of circulatory system 2. Cellular elements in the haemolymph 3. Cell mediated and humoral immunity 4. Structure of compound eye and Physiology of Vision	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	1. Sound Production in insect 2. Structure and function of endocrine glands 3. Pheromones 4. Embryonic membranous up to the formation of blastoderm	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	1. Metamorphosis 2. Insecticide effects on CNS 3. Important pest of Soybean 4. Modern concept of pest management	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

Student will be able to various types of Mouth parts, special Organs & Metamorphosis off insects physiological aspects and modern concept of pest management

**PRACTICAL:-**

**LABORATORY -I**

- Study of museum specimens of different orders and families of insects.
- Study of permanent slides.
- Taxonomic identification of insects.
- Dissection major - Nervous system of grasshopper and cockroach. Reproductive system of cockroach male and female.

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- Study of the following: • Any one sound producing organ. • Identification, classification and description: silverfish, cricket, termite, giant water bug, any one type of butterfly or moth, flesh- fly, potter wasp, long horn beetle or water beetle, dragonfly, damselfly. – use photos
- Taxonomical identification of egg, larva & pupa.
- Collection and preservation of insects.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Scientist, Academician,	Vector Biologist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist, Vector Biologist



  
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**SEMESTER- 4<sup>th</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-IV**

**PISCI CULTURE AND ECONOMIC IMPORTANCE OF FISHES (ICHTHYOLOGY)**

**Subject Code: 6SMZ0404**

**Theory Max. Marks: 50**

**Theory Min. Marks: 17**

**COURSE OBJECTIVE:**

This is the elective paper this paper introduced about the economic importance of fish.

Unit	Unit wise course contents	Methodology Adopted
<b>Unit – I</b>	1. Collection of fish seed from natural resources. 2. Dry bundh breeding of carps. 3. Wet bundh breeding of carps. 4. Hypophysation and breeding of Indian major camps.	Classroom teaching ICT tools and Google classroom,
<b>Unit – II</b>	1. Drugs useful in induced breeding of fish 2. Types of ponds required for fish culture farms 3. Management of hatcheries, nurseries and rearing ponds 4. Management of stocking ponds	Classroom teaching, ICT Based and individual presentation and Google classroom
<b>Unit – III</b>	1. Composite fish culture 2. Prawn culture and pearl industries in India. 3. Fisheries resources of MP 4. Riverine fishries.	Classroom teaching, ICT Based and individual presentation and Google classroom
<b>Unit – IV</b>	1. Costal fishries in India 2. Offshore and deep sea fishery's in India 3. Role of fishries in rural development 4. Sewage fed fishries	Classroom teaching, ICT Based and individual presentation and Google classroom, field visit
<b>Unit - V</b>	1. Methods of fish preservation 2. Marketing of fish in India. 3. Economic importance and by product of fishes 4. Shark liver oil industry in India Transport of live fish & fish seed.	Classroom teaching, ICT Based and individual presentation and google classroom, model presentation.

**COURSE OUTCOMES:**

- Differentiate between natural and induced breeding in fish. Manage hatcheries and fish farm in future.
- Develop technical knowledge of fish preservation and Shark liver oil industry.
- Identify fish by morph metric and meristic characters and apply the method in biodiversity oriented research.
- Explain and apply genetic engineering in fishery technology.

Job opportunity	Employability skill	Local/National/UNDP Goal Achieved	Enterprenurship Opportunity
Scientist, Academician,	Fishery Managment	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health & well being)	Academician, Scientist, Fish-Industry

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**SEMESTER- 4<sup>th</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-IV**  
**ENVIRONMENT & BIODIVERSITY CONSERVATION**

**Subject Code: 6SMZO405**

**Theory Max. Marks: 50**

**Theory Min. Marks:17**

**COURSE OBJECTIVE:**

From this paper the students were study about the scope of environmental biology and biodiversity.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	<ul style="list-style-type: none"> <li>Basic concept of Environmental Biology Scope and Environmental Science</li> <li>Biosphere and Biogeochemical cycles.</li> <li>Environmental monitoring and impact assessment.</li> <li>Environmental and sustainable development.</li> <li>Water conservation, rain water harvesting, water shed management.</li> </ul>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	<ul style="list-style-type: none"> <li>Cause, effects and remedial measure of Air pollution, Water pollution.</li> <li>Noise, radioactive and thermal pollution.</li> <li>Agriculture pollution</li> <li>Basic concepts of Bioaccumulation.</li> <li>Solid waste management</li> </ul>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	<ul style="list-style-type: none"> <li>Global warming and disaster management</li> <li>Cause of global warming</li> <li>Impact of global warming - acid rains and ozone depletion, green house effect.</li> <li>Control measures of global warming</li> <li>Afforestation (b) reduction in the use of CFCs</li> <li>Disaster management -floods, earthquake,</li> <li>Cyclones landslides.</li> <li>Environmental legislation.</li> </ul>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	<p><b>Natural Resources:- Forest –</b></p> <ul style="list-style-type: none"> <li>- Use and over exploitation of forests.</li> <li>- Timber extraction.</li> </ul> <p><b>Land</b></p> <ul style="list-style-type: none"> <li>- Land degradation. Landslides.</li> <li>- Soil-erosion and desertification.</li> </ul> <p><b>Water</b></p> <ul style="list-style-type: none"> <li>- Use and over utilization of surface and ground water</li> <li>- Floods. Drought dams- benefits and problems</li> <li>- Use and exploitation ,</li> <li>- Environmental effect of extracting and using mineral resources</li> </ul> <p><b>Food</b></p> <ul style="list-style-type: none"> <li>- World food problem</li> <li>- Effects of modern agriculture and overgrazing</li> </ul> <p><b>Energy</b></p> <ul style="list-style-type: none"> <li>• Conventional and nonconventional energy resources.</li> <li>• Using of alternate energy sources</li> <li>• Role of an individual in conservation of natural resources</li> <li>Equitable use of resources for sustainable life</li> </ul>	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

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Unit-V	<ul style="list-style-type: none"> <li>Conservation of Biodiversity               <ul style="list-style-type: none"> <li>Biodiversity crisis - habitat degradation poaching of wild life.</li> <li>Socio economic and political causes of loss of biodiversity.</li> <li>In situ and exsitu conservation of biodiversity</li> <li>Value of biodiversity.</li> <li>Hot spots of Biodiversity.</li> </ul> </li> <li>Field methods of studying diet.</li> <li>Examination and recording of stomach contents of a browser, grazer</li> <li>carnivore, insectivore and omnivore.</li> <li>Examination of faeces.</li> <li>Experiments with captive reptiles and mammals in various situations of ambient temperature/isolation.</li> </ul>	ICT & Green Board based Class Room Teaching, individual presentation and through Microscope
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**COURSE OUTCOMES:**

- To the study of wild life -Values of wild life, positive and negative. Our conservation ethics , Importance of conservation. Causes of depletion.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters ,biological , parameters and standard evaluation procedures.
- To the study of protected areas National parks & sanctuaries, community reserve, Important features of protected areas in India, Tiger conservation , Tiger reserve in M.P, in India, management challenges in Tiger reserve.
- Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.
- To the study of management planning of wild life in protected areas.

**PRACTICAL: (Paper III & IV)****LABORATORY -I**

- Identification and comments upon wild life animals.
- Study of endangered species.
- Study of local birds and their habit habitats.
- Study of ecosystem.
- Distribution of wild life India. (National parks and sanctuaries)
- Soil and water analysis.
- Interspecific relationship – Naturalism, Symbiosis, Mutualism, Commensalism, Parasitism, Predation Competition.
- Field – expedition and project report ucation
- Practical Record & collection.

**LABORATORY-II**

- Jar Test (removal of Suspended solid by coagulation e.g. . Use of Alum )
- Case study on Tehri project , Silent valley project , Narmada project , Ecodisaster of deforestation
- Tracing of watershed and their morphological features from toposheets
- Designing structure for water conservation and harvesting based on field visits
- To perform water ,Energy audit in the house /college building /society /laboratory
- Report on Visit to NGO/Biomedical waste management site/Hazardous waste management
- /Pollution Control facility of any industry
- Study of local Biodiversity.
- Soil analysis
- Waste water analysis.
- Field – expedition and project report
- Practical Record & collection.

Job opportunity	Employability skill	Local/National/UNDP Goal	Achieved	Enterprenurship Opportunity
Scientist, Academician, Wildlife Educator	Wildlife Activist Zoo Management	Goal 04(quality Education) Goal14(Life below water) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist, Environmental Biologist	

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**DR. C.V. RAMAN UNIVERSITY**  
KARGI ROAD, KOTA, BILASPUR (C.G.)

**SEMESTER- 4<sup>th</sup>**

**Course: M. Sc. Zoology**

**SUBJECT: DISCIPLINE SPECIFIC ELECTIVE-IV**  
**APPLIED ENTOMOLOGY**

**Subject Code: 6SMZ0406**

**Theory Max. Marks:50**

**Theory Min. Marks:17**

**COURSE OBJECTIVE:**

- To introduce classification of insects up to order level.
- To enable learners to categorize insects on the basis of morphological characteristics.
- To study the modern methods of apiculture, sericulture, lac culture to familiarize the learners to the economic aspects of apiculture.
- To study the versatile roles of insects in agriculture.

Units	Unit Wise Course Content	Methodology Adopted
<b>Unit-I</b>	1. Classification according to imms 1. Classification of apterygota upto families. 2. Classification of following insect orders (a) orthoptera (b) hemiptera (c) diptera. 3. Classification of following insect order (a) hymenoptera (b) lepidoptera (c) coleoptera 4. Collection and preservation of insects.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-II</b>	1. Insect pest-Management strategies and tools 2. Biological control 3. Genetic control 4. Chemical control	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-III</b>	1. Pests of Cotton 2. Pests of sugarcane 3. Pests of paddy 4. Pests of stored food grains 5. Pests of citrus fruits and mango 6. Pests of pulses 7. House hold insect pests	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-IV</b>	1. Insects in relation to forensic science. 2. Insects migration, population fluctuation and factors 40 3. Insects of medical and veterinary importance. 4. Ecological factors affecting the population and development of insects.	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope
<b>Unit-V</b>	1. Mulberry and non mulberry sericulture 2. Apiculture 3. Lac culture 4. Insects as human food for future	ICT & Green Board based Class Room Teaching, individual presentation and though Microscope

**COURSE OUTCOMES:**

Student will be able to classify insect up to their respective orders. Understand the difference in the life cycles of insects.: & various ecological importance of insects.

Job opportunity	Employability skill	Local/National/UNDP Goal	Enterprenurship Opportunity
Scientist, Academician,	Entomologist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)	Academician, Scientist Entomologist

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**PRACTICAL:- (Paper III & IV)****LABORATORY-II**

(Photographs, Pictures or models should be used to conduct practicals)

- Study of museum specimens of different orders and families of insects. 2. Study of permanent slides. 3. Taxonomic identification of insects.
- Observation of permanent slides or photographs of legs of honey bee.
- Study of Cockroach: Digestive system and nervous system..
- Study of pest – Stored grains pests, Fruit Pests, House hold Insect pests
- Identification, classification and description: silverfish, cricket, termite, giant water bug, any one type of butterfly or moth, flesh-fly, potter wasp, long horn beetle or water beetle, dragonfly, damselfly. – use photos
- Life cycle of lac insect, honey bee, silk moth. • Products – Lac, bee wax, silk. • Equipments used in apiculture, sericulture, lac culture.

Examples of mimicry, camouflage and concealment e.g. Plain tiger and Danaid egg fly. Stick insect, leaf insect.

**COURSE OBJECTIVE:-**

- To increase the awareness of related taken topic for our project work.
- Project Work will be assigned by the Department. Student will work on the project and submit the report. Evaluation of the Project report will be done by an External examiner. Student has to secure at least 100marks in the project work.

**PRACTICAL:-****LABORATORY - I (Paper III & IV)**

- Major dissection Nervous system of Walago, Mystus, Labeo, Tored.
- Minor dissection of internal ear, accessory , respiratory , organ , pituitary glands , Weberian ossicles . (Vertical dissection through computer aided programme may be done If dissection not allowed )
- Mounting preparation of permanent slides.
- Study of different type of scale Through Permanent slide or photographs )
- Study of crafts and gears used in fisheries
- Demonstration of induced breeding in fishes (Visual aids )
- Age determination of fish with the help of scales
- Water quality assessment of aquaculture ( pH, conductivity, TDS, total solid )
- Taxonomical status of local fishes
- Demonstration of oparantal care in fishes (visual aids )through visit to any fish f
- Spotting of museum specimen slides and bones
- Practical record , collection.

**LABORATORY -II**

- Systematic identification of freshwater fishes with particular reference to M.P
- Qualitative zooplankton analysis
- Nutrient analysis of water
- Aquarium design and maintenance
- Visit to freshwater
- Estimation of hydro biological parameters- temperature, pH, conductivity, salinity, dissolved oxygen, primary productivity, ammonia, nitrite, nitrate, phosphate, biological oxygen demand, chemical oxygen demand of nursery, rearing, stocking and breeding ponds
- Demonstration of breeding pools and hatcheries
- Induced breeding of Indian major carps and catfishes.
- Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India.
- Collection and identification of aquatic weeds and aquatic insects.

Job opportunity	Employability skill	Local/National/UNDP Achieved	Goal	Enterprenurship Opportunity
Scientist, Academician,	Vector Biologist, Entomologist	Goal 04(quality Education) Goal 15(Life on Land) Goal 03(Good health &well being)		Academician, Scientist, Vector Biologist, Entomologist

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