

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of Syllabus

For

M.Sc. Zoology

(Based on NEP 2020 framework)
(To be implemented from the Academic Year 2023-24)

Semester 1 (First Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 4+4+2)	23ScZooP111	Major Paper 1 (Theory)	Biochemistry and Molecular Biology	4	4	50	50	100
	23ScZooP112	Major Paper 2 (Theory)	Cell Biology and Developmental Biology	4	4			
	23ScZooP113	Major Paper 3 (Theory)	Practicals Lab 1(Based on all theory paper)	4	4			
	23ScZooP114	Major Paper 4 (Practical/Theory)	Freshwater Zoology	2/4	2	25	25	50
Major Electives (4)	23ScZooP121	Major Elective 1 (T/P)	Fundamentals of Systematics and Environmental Biology	4	4	50	50	100
	23ScZooP122	Major Elective 2 (T/P)	Fundamentals of Systematics and Aquaculture	4				
RM (4)	23ScZooP131	RM Paper 1	RM Core Paper	2	4	50	50	100
	23ScZooP131	RM Paper 2	Biological Techniques	2				
OJT(4),		—	—	—	—	—	—	—
Total				22/26/28	22	175	175	350

Semester 2 (First Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 4+4+2)	23ScZooP211	Major Paper 1 (Theory)	Metabolic Pathways and Advanced Genetics	4	4	50	50	100
	23ScZooP212	Major Paper 2 (Theory)	Physiology and Endocrinology	4	4			
	23ScZooP213	Major Paper 3 (Theory)	Practicals Lab 2(based on theory subjects)	4	4			
	23ScZooP214	Major Paper 4 (Practical/Theory)	Basic Entomology and Biodiversity	2/4	2	25	25	50
Major Electives (4)	23ScZooP221	Major Elective 1 (T/P)	Biostatistics and Animal Biotechnology	4	4	50	50	100
	23ScZooP222	Major Elective 2 (T/P)	Biostatistics and Medical Microbiology	4				
RM (4)		—	—	—	—	—	—	—
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OJT(4),	23ScZooP241	OJT	On Job Training	8	4	50	50	100

Total				30/32	22	175	175	350
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Semester 3 (Second Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 4+4+2)	23ScZooP311	Major Paper 1 (Theory)	Entomology and Insect Physiology and Biochemistry	4	4	50	50	100
	23ScZooP312	Major Paper 2 (Theory)	Immunology and Histochemistry	4	4			
	23ScZooP313	Major Paper 3 (Theory)	Practicals Lab 3(Based on theory subjects)	4	4			
	23ScZooP314	Major Paper 4 (Practical/Theory)	rDNA Technology	4/2	2	25	25	50
Major Electives (4)	23ScZooP321	Major Elective 1 (T/P)	Bioinformatics and Genomics and Proteomics	4	4	50	50	100
	23ScZooP322	Major Elective 2 (T/P)	Bioinformatics and Parasitology	4				
RP (4)	23ScZooP352	RP	Research Project	8	4	50	50	100
OJT(4),								
Total				26/28	22	175	175	350

Semester 4 (Second Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 4+4+2)	23ScZooP411	Major Paper 1 (Theory)	Bacterial and Phage Genetics and Genetic Toxicology	4	4	50	50	100
	23ScZooP412	Major Paper 2 (Theory)	Animal Tissue Culture and Mammalian Reproductive Physiology	4	4			
	23ScZooP413	Major Paper 3 (Theory)	Practicals Lab 4(based on theory subjects)	4	4			
	23ScZooP414	Major Paper 4(P/T)	Evolution	2/4	2	25	25	50
Major Electives (4)	23ScZooP421	Major Elective 1 (T/P)	Ecology and Animal Behaviour	4	4	50	50	100
	23ScZooP422	Major Elective 2 (T/P)	Ecology and Pest Control	4				
RP (4)	23ScZooP452	RP	Research Project	12	6	75	75	150

OJT(4),								
Total				22	22	175	175	350

OE : Open Elective

AEC: Ability Enhancement Course

VEC: value Education Courses

CC : Co-Curricular Courses

IKS : Indian Knowledge System

OJT : On Job Training

FP : Field Project

VSC : Vocational Skill Courses

CEP : Community Engagement Project

Progressive Education Society's
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P.G. Part I Year of M.Sc. Zoology SEM I
(2023 Course under NEP 2020)

Course code: : 23ScZooP111 **Course Name : Biochemistry and Molecular Biology**
Teaching Scheme: TH 4Hours/Week **Credit - 04C**
 Examination Scheme: CIA : 50Marks End-Sem : 50 Marks

Course Objectives:

- To introduce basic biochemistry
- To learn significance, structures of different biomolecules
- To understand the central dogma of life
- To study different types of mutations
- To study and understand the importance of different transposable elements

Course Outcomes:

On completion of the course, student will be able to–

- Use the learnt structures to understand metabolic reactions
- Understand the interrelationship between different biomolecules
- Students shall understand the flow of genetic information
- Students shall be able to understand the differences in genomes and life processes of prokaryotes and eukaryotes.

Course Contents:Biochemistry

Unit 1	Water	2Lectures
	1.1 Structure and function 1.2 pH and Buffers 1.3 Biological Buffer System Problems and concepts related to mole, molarity, normality, buffers etc.	
Unit 2	Carbohydrates	4Lectures
	2.1 Classification and Biological Significance, Chemical Structures, 2.2 Properties and derivatives of monosaccharides; disaccharides, concept of invertose, reducing and non reducing sugars, polysaccharides – structure and importance 2.3 Disorders of carbohydrate metabolism - Diabetes mellitus, glycogen storage diseases	
Unit 3	Lipids	3Lectures
	3.1 General features and Classification 3.2 Structure and function of major lipid subclasses. 3.3 Mobilization and transport of triglycerols 3.4 Steroid hormones and bile acids	
Unit 4	Amino acids	3Lectures
	4.1 Classification – Standard and non-standard with structures 4.2 Properties – Optical properties, absolute configuration, Titration of amino acids, calculation of pK and pI values, Absorption of U.V. light.	
Unit 5	Proteins	7Lectures

	5.1 Peptide bond and its formation, Simple and conjugated proteins 5.2 Protein structure :i. Primary structure and its importance, properties of peptide bond, Ramachandran plot ii. Secondary structure-types iii. Tertiary structure: myoglobin, domains and motifs iv. Quaternary structure- haemoglobin, 5.3 Isoelectric precipitation, salting in and salting out, Denaturing conditions, Reanturation, folding by chaperons 5.4 Protein sequencing by Edman degradation and protein purification 5.5 DNA binding motifs - helix turn helix, zinc fingers, leucine zippers, helix loop helix	
Unit 6	Enzymes	8Lectures
	6.1 Classification, nomenclature and properties 6.2 Enzyme kinetics , Factors affecting enzyme activity, Significance of Km and Vmax, Turnover number, significance of Kcat Lineweaver Burk plot Measures of enzyme activity 6.3 Enzyme inhibition – Reversible and irreversible inhibition with equations 6.4 Regulatory Enzymes. 6.5 Isozymes, Ribozymes, Zymogens 6.6 Biochemical diagnosis of diseases by enzyme assays - SGOT, SGPT	
Unit 7	Vitamins and Coenzymes	3Lectures
	7.1 Classification, water-soluble and fat-soluble vitamins 7.2 Coenzyme forms and their significance	

Molecular Biology

Unit 1	Genome organization	3Lectures
	1.1 DNA structure and topology - Structure of chromatin, nucleosome, chromatin organization and remodeling, higher order organization, Histone and its effect on structure and function of chromatin 1.2 C value, C value paradox, Cot curves, repetitive and non-repetitive DNA sequence, Cot ½ values, Pseudogenes , Gene families.	
Unit 2	DNA damage and repair	5Lectures
	2.1 Different types in DNA damages 2.2 Different DNA repair systems: Direct repair, Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, Double strand break repair, Nick Translation and SOS Repair.	
Unit 3	DNA Replication	06Lectures

	3.1 DNA replication in E. coli, Origin of replication, types of E. coli DNA polymerases, details of replication process, regulation of replication, 3.2 Different models of replication for linear and circular DNA, Eukaryotic DNA replication, multiple replicons, eukaryotic DNA polymerases, details of eukaryotic replication, connection of replication to cell cycle, Telomere synthesis, inhibitors of replication.	
Unit 4	Transcription	06 Lectures
	4.1 Transcription in prokaryotes and eukaryotes, role and significance of promoter, enhancer, silencer, Transcriptional factors, mechanism of prokaryotic gene transcription, structure of RNA polymerase II, details of transcription process 4.2 Post transcriptional processing: Capping, polyadenylation and Types of splicing in eukaryotes. Spliceosome assembly, RNA Editing.	
Unit 5	Gene Expression in Prokaryotes and Eukaryotes - Translation	5 Lectures
	5.1 Protein synthesis: Genetic Code, ribosome structure, activation of amino acids, peptide bond formation and translocation of Peptides. Termination in prokaryotes and eukaryotes 5.2 Post-translational modifications, inhibitors of protein synthesis	
Unit 6	Mobile DNA elements	3 Lectures
	6.1 Transposable elements in bacteria, IS elements, types of transposons, replicative, non-replicative transposons, Mu transposition. Controlling elements in Tn A and Tn 10 transposition, 6.2 SINES and LINES.	
Unit 7	Techniques in Molecular Biology	2 Lectures
	7.1 Determination of gene function - Gene silencing – RNAi pathway (siRNA and miRNA) 7.2 DNA footprinting,	

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2. Biochemistry 6th Ed, (2007) Berg Jeremy, Tymoczko John, Stryer Lubert, Publisher: W. H. Freeman, New York.
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4. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.
5. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.

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9. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 26
10. Molecular Biology, 4th Edition (2007), Weaver R., Publisher-McGraw Hill Science.
11. Molecular Biology of the Cell, 4th Edition (2004), Bruce Alberts, Dennis Bray, Julian
12. Lewis, Martin Raff, Keith Roberts, and James D. Publisher: Garland Publishing.
13. Essential Cell Biology, 2nd Edition (2003) Bruce Albert, Dennis Bray, Karen Hopkin,
14. Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Publisher: Garland Publishing.
15. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Publisher: Oxford University Press.

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P.G. Part 1 Master of Science SEM I
(2023 Course under NEP 2020)

Course Code : 23ScZooP112 Course Name : Cell Biology and Developmental Biology

Teaching Scheme: TH 4Hours/Week

Credit - 04C

Examination Scheme: CIA : 50Marks

End-Sem : 50 Marks

Prerequisite: Bachelor of Science

Course Objectives:

- To study chemical nature of the Cell.
- To study role of Macro-molecules & functions of living systems.
- To introduce students to different branches of Genetics
- To make them understand heredity principles

Course Outcomes:

On completion of the course, student will be able to–

- The students will understand the significance and importance of cell as a structural and functional chapter of life.
- The students will know the logic of the techniques used in cell biology
- The students will learn the complex functions and processes of the cell
- Students would be aware about modern implications of developmental biology by
- impartment of knowledge regarding teratogenesis, in-vitro fertilization, stem cells
- and amniocentesis techniques

Course Contents:

Unit 1	Introduction to Cell	3 Lectures
	1.1 Types & Shapes of cell 1.2 Chemical nature of cell 1.3 Biologically important molecule, Macromolecules and their role in form and function of living systems. 1.4 Stem Cells, types & characteristics	
Unit 2	Plasma membrane	3 Lectures
	2.1 Structure, Fluid mosaic model 2.2 Intrinsic and extrinsic proteins, membrane proteins and its functions. 2.3 Hormone receptors on plasma membrane, their structure & role in signal transduction. 2.4 Membrane potential and synaptic transmission; 2.5 Glycocalyx; cell junction, cell adhesion molecules, channels Active & passive transport- transport proteins, Na/K pump, proton pump, exocytosis, endocytosis, facilitated diffusion.	
Unit 3	Endomembrane system:	6 Lectures
	3.1 EM Structure & functions of cell organelles (ER, Golgi complex, Lysosomes, Glyoxysome, Peroxisomes)	

	3.2 Protein trafficking.	
Unit 4	Mitochondria & Chloroplast	3 Lectures
	4.1 Structure & Function 4.2 Protein import 4.3 Structure & function of F1 particles	
Unit 5	Nucleus:	3 Lectures
	5.1 Ultrastructure, nuclear envelope, nuclear lamina, nuclear pore complex, nuclear cytoplasmic interactions, nucleoporins 5.2 Nucleolus, Nuclear lamina and its role in cell division 5.3 Nuclear localization sequences 5.4 Mechanism of nuclear transport	
Unit 6	Cell Cycle	5 Lectures
	6.1 Cell division, Phases, Check points of cell cycle mechanism of regulation (Cyclin and cyclindependent kinases) Regulation of CDK cyclin activity, control by MPF 6.2 Role of p53, Rb	
Unit 7	Cytoskeleton:	3 Lectures
	7.1 Types, Chemistry, structure and functions of microtubules, microfilaments and intermediate filaments. 7.2 Organisations, associated proteins and their role 7.3 Inhibitors, extracellular matrix, support 7.4 Motility and regulation 7.5 Centrosomes and centrioles, cilia and flagella	
	Developmental Biology	5 Lectures
Unit 1	Basic concepts of Developmental Biology:	2 Lectures
	1.1 Animal Model systems : Fish, Frog, Chick, Mouse and <i>Drosophila</i> , <i>Hydra</i> 1.2 Terminologies related to Development Biology	
Unit 2	Gametogenesis - Spermatogenesis and Oogenesis	5 Lectures
	2.1 Origin of Primordial germ cells 2.2 Structure of sperm, 2.3 Regulation of sperm motility 2.4 Factors controlling spermatogenesis 2.5 Role of dyenin ATPase, role of pH and divalent cation. 2.6 Structure of egg, synthesis and storage of maternal transcripts, proteins and cell organelles, 2.7 rDNA amplification, transcription lampbrush chromosomes, vitellogenesis, 2.8 Types of yolk, Functions, formation of egg membranes	
Unit 3	Fertilization	3 Lectures

	3.1 Mechanism of fertilization : Species specific sperm attraction, recognition of egg and sperm, acrosome reaction, signal transduction, 3.2 Activation of ovum, regulation of cell cycle and utilization of maternal macromolecules and organelles during early development 3.3 Molecular strategy to ensure mono-spermy and polyspermy species specificity in fertilization. Significance	
Unit 4	Cleavage ,Blastulation, Gasrulation and Neurulation	6 Lectures
	4.1 Types of eggs and cleavage patterns: Concepts in Pattern formation, animal vegetal axis, gradients, origin, and specification of germ layers, Fate maps 4.2 Tubulation: Neurogenesis , growth and differentiation	
Unit 5	Organizers	3 Lectures
	Role of Spemann's organizers in frog and Hensen's node in birds.Functions of Organizers	
Unit 6	Mesoderm induction in <i>Xenopus</i>	3 Lectures
	6.1 Role of signals in dorsal, intermediate and ventral mesoderm induction,Progressive Determination of the Amphibian Axes 6.2 Neural competence and molecular signaling during neural induction	
Unit 7	Pattern formation in <i>Drosophila</i>	3 Lecture
	Bicoid , Nanos and Torso Morphogen gradients and regulation of Hunchback	
Unit 8	Stem cells and its development	4 Lecture
	8.1 Origin, Types of stem cells, Characteristics, functions 8.2 Concept of growth, differential cell proliferation, shaping of organ primordia and programmed morphogenetic cell death. 8.3 Growth and post embryonic development: Apoptosis, aging and senescence. Hayflicks experiment.	

References

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. (1995). Molecular Biology of the Cell. Eds. 3, Garland Publi. New York and London.
2. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (1995). Molecular Cell Biology, Eds. 3, Scientific American & W. H. Freeman. New York.
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5. *Principles of Development*, 3rd edition (2007), Lewis Wolpert, Publisher- Oxford University Press.
6. *An Introduction to Embryology*, 5th edition (2004), B. I. Balinsky. Publisher - Thomas Asia Pvt. Ltd.
7. *Developmental Biology*, (2001), R. M. Twyman, Publisher - Bios Scientific Publishers LTD.
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P.G. Part 1 Master of Science SEM I
(2023 Course under NEP 2020)

Course Code : 23ScZooP113 Course Name : Practical Lab 1
Teaching Scheme: TH 4Hours/Week Credit - 04C
Examination Scheme: CIA : 50 Marks End-Sem : 50Marks

Prerequisite Courses:
Bachelor of Science

Course Objectives:

- To understand basic biochemistry, cell biology, developmental biology and environmental biology by actually performing related experiments
- To observe fresh water fauna in the field as well as in the laboratory

Course Outcomes:

- The students will have an hands on training experience in biochemistry, cell biology, freshwater Zoology, Developmental Biology and Environmental Biology.
- Students shall be able to understand the interrelationship between different biotic and abiotic factors in fresh water ecosystems

Course Contents

Sr. No.	Name of the Practical	No. of Practicals
	Biochemistry	
1.	Preparation of Buffers of given pH and molarity and measurement of pH of various samples.	1P
2.	Estimation of protein by FolinCiocalteu method.	1P
3.	Estimation of Vitamin C	1P
4.	Units and specific activity of enzymes and progressive curve	1P
5.	Effect of substrate concentration on enzyme activity	1P
6.	Effect of pH and temperature on enzyme activity.	1P
7.	Effect of activators and inhibitors on enzyme activity.	1P
8.	Estimation of amino acids by paper chromatography and dyes by TLC.	1P
9.	To find absorption spectrum of haemoglobin, BSA, Tyrosine.	1P
10.	Estimation of Glucose by DNSA	
	Cell Biology and Developmental Biology	

11.	Cell fractionation- Nuclei isolation and nuclear count.	1P
12.	Preparation of blood smears: Cell type identification and differential counts	1P
13.	Ultra structure of cell organelles.	1P
14.	Study of Cyclosis in <i>Paramecium</i>	1P
15.	Mounting of chick embryos and preparation of permanent mounts, Gross anatomy and histology of chick embryo upto 72 hrs. Brain, heart, lens, ear development.(18 hrs., 24 hrs., 33hrs., 48 hrs. WM)	1P
16.	Drosophila development on live material: egg structure, egg laying and early development in culture by phase contrast	2P
17.	Study of effect of ligature in Drosophila / House fly larva	1P
18.	Study the imaginal disc in Drosophila larva	1P
19.	Chick limb bud staining with neutral red for morphogenetic cell death	1P
20.	Regeneration of Hydra/Planaria	1P
21.	Cell fractionation- mitochondria isolation and observation	1P
	Fresh Water Zoology	1P
22.	A qualitative and quantitative analysis of zooplankton from a given sample of water using Sedgwick rafter counting cell.	1P
23.	Study of aquatic and semi-aquatic adaptations in amphibians and reptiles.	1P
24.	Study of locomotory and respiratory adaptations in aquatic insects and their larvae.(<i>Ranatra</i> , <i>Notonecta</i>)	1P
25.	Estimation of Chlorides in given sample of water,	1P
26.	Study of locomotory and respiratory adaptations in aquatic insects and their larvae.(<i>Gerris</i> , <i>Belostoma</i> , <i>Dytiscus</i>)	1P
27.	Analysis of LC50 for known pollutants.	1P
28.	Compulsory Visit to ZSI, Pune and water purification plant and submission of tour report.	1P
29.	Water analysis with regards to hardness.	1P
30.	Determination of DO from water sample	1P

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PG Part 1 Year of M.Sc. (Zoology) SEM I
(2023 Course under NEP 2020)

Course Code : 23ScZooP114

Teaching Scheme: TH 2Hours/Week

Examination Scheme: CIA :25 Marks

Course Name : Freshwater Zoology

Credit - 02C

End-Sem : 25 Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To learn freshwater diversity and their interaction with the environment
- To study the basic properties of aquatic ecosystem and causes of water pollution

Course Outcomes:

On completion of the course, student will be able to–

- Understand importance of freshwater ecosystem
- Understand the aquatic biodiversity and their adaptive features
- Recognize different types of environment pollution and the effect of different pollutants on organisms.
- Have critical understanding of environmental impact.

Course Contents

Unit 1	Types of Aquatic environment	3Lectures
	1. 1 Lotic Habitat 1.2 Lentic Habitat 1.3 Ephemeral water bodies 1.4 Zonation of fresh water bodies	
Unit 2	Physical conditions of water	3Lectures
	2.1 Movement of water, Depth, Viscosity, Turbidity, Density, Buoyancy, Temperature and light, Stratification, Transparency	
Unit 3	Chemical conditions of water	2Lectures
	3. 1 Dissolved oxygen and Carbon di-oxide, phosphates, Nitrates. Acidity and alkalinity, Mg-hardness, Ca-hardness, dissolved solids, organic Matter. 3.2 Nutrient cycles in lakes	
Unit 4	Physiological and protective adaptations of the following	3Lectures
	4.1Protozoa, Rotifera, Crustaceans and Fishes	
Unit 5	Animal diversity in freshwater habitats	5Lectures
	5.1 1Diversity of animals from freshwater habitats 5.2Different zooplanktons common in fresh water	

Unit 6	Diagnostic features and life cycle of	3Lectures
	6.1 Fairy shrimps and tadpole shrimps (temporary rainwater pool animals)	
Unit 7	Respiratory and Locomotory adaptations in freshwater insects and their larvae	3Lectures
	7.1 Different types of respiratory adaptation in some freshwater insects 7.2 Different types of locomotory adaptation in some fresh water insects.	
Unit 8	Amphibians and aquatic adaptations	2Lectures
	8.1 General life cycle of frog 8.2 Trophic status of Tadpole in freshwater habitat	
Unit 9	Fresh water Management	5Lectures
	9.1 Causes of aquatic pollution: agricultural, industrial, thermal 9.2 Eutrophication 9.3 Biological changes in freshwater due to sewage pollution, sewage treatment	

References:

1. Mellanby, H (1975). Animal life in freshwater, 6th edition, Chapman-Hall
2. Limnology: Welch P.S. (1975). Mc. Grall and Hill Co. New York.
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PG Part 1 Year of M.Sc. (Zoology) SEM I
(2023 Course under NEP 2020)

Course Code : 23ScZooP121 Course Name : Fundamentals of Systematics and Environmental science

Teaching Scheme: TH 4Hours/Week

Credit - 04C

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To make students understand the basic concepts of classification and systematics and its importance
- To clear the concept of species and its types.
- To enable the student classify and identify different organisms by running taxonomic keys
- To introduce detailed concepts in environment and its different biotic and abiotic components.
- To make students understand the concept of bio concentration and bioaccumulation of different lethal pesticides in environment and their effect.
- To introduce in detail the concepts of biomedical waste and hazardous waste.

Course Outcomes:

On completion of the course, student will be able to–

- The students can run taxonomic keys and identify different organism based on keys
- The students have a clear idea about the modern methods of classification and identification based on molecular phylogenetics.
- Analyze the contribution of microbiology area of science in water treatment, solid waste management, bioremediation and phytoremediation.
- Know about biomedical and hazardous waste and process of handling and disposing them.
- Solve the environmental problems involving interaction of humans and natural systems at local or global level

Course Contents

Unit 1	Introduction to Systematics	3Lectures
	1.1 Biological classification	

	1.2Taxonomic Characters: procedure and keys 1.3Species concept: varieties, subspecies, sibling species, race etc	
Unit 2	Kingdoms of life	5Lectures
	2. 1General outline of Kingdom Monera, Protista, Fungi, Plantae 2.2 Broad outline of Kingdom Animalia	
Unit 3	Methodologies of systematics	4Lectures
	3.1Morphology based taxonomy 3.2Numerical taxonomy, Cyto-taxonomy and chemo taxonomy 3.3Molecular Systematics 3.4DNA fingerprinting 3.5Molecular Markers and detection of polymorphism RFLP,RAPD	
Unit 4	Taxonmic Keys:	5Lectures
	4. 1Types of keys 4.2Merits and demerits of different keys.	
Unit 5	International Code for Zoological Nomenclature	5Lectures
	5.1Operative principles 5.2Interpretation and application of different rules. 5.3Zoological nomenclature: formation of names	
Unit 6	Taxonomic Procedures	5Lectures
	6.1Taxonomic collection and preservation process 6.2Curetting process	
Unit 7	Molecular phylogenetics	3Lectures
	7.1 Types of phylogenetic trees 7.2 Methods in molecular phylogenetics	

	Environmental Science	
Unit 1	Fundamentals of Environmental Sciences	3 Lectures
	1.1. Definition, Principles and Scope of Environmental Science. 1.2 Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere 1.3 Biogeographic provinces of the world and agro-climatic zones of India. Concept of sustainable development.	
Unit 2	Environmental Chemistry	3 Lectures
	2.1 Composition of air. Particles, ions and radicals in the atmosphere, Photochemical smog. 2.2 Hydrological cycle. Concept of DO, BOD and COD. Sedimentation, coagulation, flocculation, filtration, pH and Redox potential (Eh). 2.3 Biogeochemical cycles – nitrogen, carbon, phosphorus and sulphur	
Unit 3	Environmental Pollution and Control	8 Lectures
	3.1 Air pollution and pollutants 3.2 Water pollution and pollutants 3.3 Soil Pollution and pollutants	

	3.4 Pesticide pollution and its impact 3.5 Noise pollution 3.6 Thermal pollution 3.7 Marine Pollution 3.8 Radioactive pollution	
Unit 4	Hazardous waste management	3 Lectures
	4.1 Hazardous waste management: Treatment Methods – neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal. 4.3 Electronic waste (e-waste) and its environmental consequences.	
Unit 5	Environmental Monitoring, Assessment, Management and Legislation	7 Lectures
	5.1 Aims and objectives of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP). 5.2 Remote Sensing and GIS: Principles of remote sensing and GIS 5.2 Overview of Environmental Laws in India: Biological Diversity Act, 2008, Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2016, The Bio-Medical Waste Management Rules, 2016, The e-waste (Management and Handling) Rules 2011, 2016,	
Unit 6	Current Environmental Issues in India:	2 Lectures
	6.1 National river conservation plan – Namami Gange and Yamuna Action Plan. 6.2 Forest Conservation – Chipko movement, Appiko movement, Silent Valley movement and Gandhamardhan movement. 6.3 Waste Management – Swachha Bharat Abhiyan 6.4 Environmental Disasters: Minnamata Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukushima Daiichi nuclear disaster, 2011	
Unit 7	Environmental microbiology	3 Lectures
	7.1 Introduction to environmental microbiology 7.2 Bioremediation of waste water - waste water treatment, bio-filters, microbial polymers, microbial plastics, Bioaccumulation, Biomagnification, marine pollution.	
Unit 8	Green Technology	1 Lecture
	8.1 Overview, principles and applications	

References

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2. Biodiversity, Wilson A.O., Academic Press, Washington.
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PG Part 1 Year of M.Sc. (Zoology)
(2023 Course under NEP 2020) SEM I

Course Code : 23ScZooP122 Course Name : Fundamentals of Systematics and Aquaculture

Teaching Scheme: TH 4Hours/Week

Examination Scheme: CIA : 50 Marks

Credit - 04C

End-Sem : 50 Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To make students understand the basic concepts of classification and systematics and its importance
- To clear the concept of species and its types.
- To enable the student classify and identify different organisms by running taxonomic keys.
- To understand the principles of aquaculture, including production system, water quality and nutrition.

Course Outcomes:

On completion of the course, student will be able to–

- The students can run taxonomic keys and identify different organism based on keys
- The students have a clear idea about the modern methods of classification and identification based on molecular phylogenetics.
- Understand the aquaculture systems.
- Understand conditioning factors in aquaculture and how they can be manipulated.
- Understand the environmental impacts of aquaculture.

Course Contents

Unit 1	Introduction to Systematics	3Lectures
	1.1 Biological classification 1.2 Taxonomic Characters: procedure and keys 1.3 Species concept: varieties, subspecies, sibling species, race etc	
Unit 2	Kingdoms of life	5Lectures
	2. 1 General outline of Kingdom Monera, Protista, Fungi, Plantae 2.2 Broad outline of Kingdom Animalia	
Unit 3	Methodologies of systematics	4Lectures
	3.1 Morphology based taxonomy	

	3.2 Numerical taxonomy, Cyto-taxonomy and chemo taxonomy 3.3 Molecular Systematics 3.4 DNA fingerprinting 3.5 Molecular Markers and detection of polymorphism RFLP, RAPD	
Unit 4	Taxonomic Keys:	5 Lectures
	4.1 Types of keys 4.2 Merits and demerits of different keys.	
Unit 5	International Code for Zoological Nomenclature	5 Lectures
	5.1 Operative principles 5.2 Interpretation and application of different rules. 5.3 Zoological nomenclature: formation of names	
Unit 6	Taxonomic Procedures	5 Lectures
	6.1 Taxonomic collection and preservation process 6.2 Curation process	
Unit 7	Molecular phylogenetics	3 Lectures
	7.1 Types of phylogenetic trees 7.2 Methods in molecular phylogenetics	

	Aquaculture	
Unit 1	Scope and systems of Aquaculture	7 Lectures
	1.1 Introduction: Present status, problems and scope of fish farming in global and Indian perspective. 1.2 Aquaculture systems: Extensive, semi-intensive and intensive culture of fish, Pen and cage culture in lentic and lotic water bodies, polyculture, composite fish culture. 1.3 Culture systems: Freshwater prawn culture, fish culture in paddy fields, Brackish water culture, Mariculture: Oyster culture, Crab culture, Lobster culture, mussel culture, culture of Eels, Culture of aquatic weeds.	
Unit 2	Fish Farming	4 Lectures
	2.1 Fish farming: Nursery pond preparation, stocking, feeding and water quality management in the farming of major and minor carps, magur, tilapia, etc.; 2.2 Stunted seed production and culture practice. 2.3 Transport of fish seed and Brood fish. Causes of mortality in transport	
Unit 3	Fish pathology	6 Lectures
	3.1 Parasitic infections 3.2 Fungus infections 3.3 Protozoan diseases 3.4 Worm diseases	
Unit 4	Integrated farming	6 Lectures
	4.1 Integrated farming systems: Design, farming practices 4.2 IFS of fish with paddy, cattle, pig, poultry, duck, rabbit, etc.	
Unit 5	Seed production and hatchery management	7 Lectures

	5.1 Introduction: History, constraints and current status of natural seed collection and hatchery seed production of Finfishes and shellfishes. 5.2 Reproductive biology and Induced breeding of Finfish 5.3 Reproductive biology and Induced breeding of Shellfish 5.4 Hatchery design and management	
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PG Part 1
(2023 Course under NEP 2020) SEM I
Course Code : 23ScZooP131 Course Name : Research Methodology

Section 1

Teaching Scheme: 2 Hours/Week

Credit : 02

Examination Scheme: CIA :25 Marks

End-Sem : 25 Marks

Prerequisite Courses:

- B.A., B.Sc. B.Com,B.Voc., BBA, BBA IB, BBA CA

Course Objectives:

- To make students aware about research and its importance
- To obtain knowledge regarding systematic gathering of data and get advanced knowledge in the selected topic
- To inculcate logical and organized thinking in students
- To investigate some existing situation or problem by creating new system or method
- To help students to design research problem

Course Outcomes:

On completion of the course, student will be able to–

1. Describe importance of research
2. Differentiate between unethical and ethical practices of publication ethics
3. Select research problem appropriately
4. Prepare good hypothesis
5. Design research problem systematically
6. Analyze and organize data correctly
7. Prepare good scientific research report

Course Contents

Unit 1	Research problem and design	No. of lectures
	Introduction to research :meaning and definition of research, objective of research, importance of research, characteristics of good research, purpose and role of research, classification of research Research problem : defining of research problem,	15

	Criteria for selecting the research problem, , importance of literature survey in defining research problem. Hypothesis :Defining Hypothesis, types of hypothesis, characteristics of good hypothesis, formulation of hypothesis Research Design :Definition and features of research design, Concept of research design, types of research design, preparation of research design, Sampling techniques, characteristics of good sampling designs	
Unit 2	Data analysis, report writing and publication ethics	15
	Definition of Data, methods of data collection, analysis of data, types of data analysis, Questionnaire, Design of Questionnaire, Testing hypothesis : parametric and non-parametric tests : T-test, Z-test, Chi-square test, ANOVA Report writing : importance of interpretation of results, meaning, definition and significance of report /thesis writing, Principals of research report drafting, Types of reports, layout of research report, important parts of reports, precautions of preparation of report/ thesis Publication ethics :definition, introduction and importance, best practices/ standard settings initiative and guidelines COPE, WAME, etc, conflict of interest, Publication misconduct :definition, concept problems that lead to unethical behavior, violation of publication ethics, predatory publishers and journals, software tools to identify predatory publications developed by SPPU	

References :

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- C. G. Thomas (2021) *Research Methodology and Scientific Writing*, 2nd Edition, Springer Nature, New York.

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P.G. Part I Year of M.Sc.Zoology SEM I
(2023 Course under NEP 2020)

Course Code : 23ScZooP131

Course Name: Biological Techniques

Teaching Scheme: TH2Hours/Week

Credit - 02C

Examination Scheme: CIA :25Marks

End-Sem : 25Marks

SECTION II

Course Objectives:

- To learn different techniques used in biology
- To study the applications and working of basic biological techniques

Course Outcomes:

On completion of the course, student will be able to–

- Understand the principle of biochemical techniques
- Design experiments using different biochemical techniques

Unit1	Chromatography	8Lectures
	1.1 Principles and applications of: Adsorption chromatography Partition chromatography 1.2 Ion-exchange chromatography, affinity chromatography, Molecular exclusion chromatography, thin layer chromatography, HPLC, RPLC 1.3 Selection of chromatographic system.	
Unit2	Electrophoresis	4Lectures
	2.1 Moving boundary electrophoresis, zone electrophoresis, 2.2Different supports used for electrophoresis, electrophoresis under native, dissociating and denaturing conditions, electrophoresis of nucleic acids and proteins, microchip electrophoresis	
Unit3	Centrifugation	3Lectures
	3.1 Principle, basic theory of ultracentrifugation 3.2 Molecular weight determination and its applications	
Unit4	DNA and protein sequencing	5Lectures

	4.1 Sangers and Maxam Gilbert method of sequencing, clone contig and shotgun approaches 4.2 Protein sequencing methods	
Unit5	Blotting	3Lectures
	5.1 Types of blotting - Southern, Northern and Western 5.2 Dot blots	
Unit6	Radioactivity	3Lectures
	6.1 Properties of radioisotopes, commonly used isotopes, structure & working of G.M. counter, use of isotopes in biology 6.2 Radiation hazards.	
Unit7	Mass spectrometric techniques	4Lectures
	7.1 Introduction, Ionisation, Mass analysers, Detectors 7.2 Analysing protein complexes	

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1. Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.
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SEMESTER II

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P.G. Part I Year of M.Sc.Zoology **SEM II**
(2023 Course under NEP 2020)

Course code: 23ScZooP211 Course

**Name : Metabolic Pathways and
Advanced Genetics**

Teaching Scheme: TH 4Hours/Week

Credit - 04C

Examination Scheme: CIA : 50Marks

End-Sem : 50 Marks

Course Objectives:

- To give a detailed outline of metabolism
- To make students understand the changes in biochemical reactions under different physiological conditions.
- To introduce students to different branches of Genetics
- To make them understand heredity principles

Course Outcomes:

On completion of the course, student will be able to–

- Understand the interrelationship between different biomolecules and their pathways
- Understand different disease conditions related to enzymes
 - Predict the phenotype of organisms by studying genotypes
 - Understand mechanisms of different fields of Genetics and solve numericals.

Course Contents: Metabolic Pathways

Unit1	Carbohydrate metabolism	11Lectures
	8.1 Glycolysis, feeder pathways, gluconeogenesis, pentose phosphate pathway, Glyoxalate cycle, regulation Glycogen metabolism and its hormonal regulation 8.2 The Citric acid cycle: Cyclic overview and reactions. Metabolic sources of acetyl CoA. Regulation and amphibolic nature of the cycle, Anapleurotic reactions 8.3 Dark reactions and Light reactions of Photosynthesis: CO ₂ fixation: C ₃ , C ₄ and CAM pathways.	
Unit2	Lipid metabolism	6Lectures
	9.1 Oxidation of unsaturated and saturated fatty acid and its regulation. 9.2 Propionyl CoA metabolism, significance, synthesis and utilization of ketone bodies, Biosynthesis of palmitate and its regulation. 9.3 Mitochondrial and peroxisomal oxidation	

Unit3	Amino acid metabolism	5Lectures
	10.1 Oxidative degradation of amino acids: transamination, oxidative deamination 10.2 Ureacycle, Ammonia excretion	
Unit4	Nucleotide Metabolism	4Lectures
	11.1 Salvage and <i>de novo</i> pathways of purine and pyrimidine Nucleotide synthesis, regulation 11.2 Nucleotide degradation pathways, Acidosis and Gout	
Unit5	Oxidative phosphorylation – Electron transport chain, Q cycle, ATP synthesis, Decouplers	4Lectures

Unit1	Mendelian Genetics and Linkage	5 Lectures
	1.1 Recapitulation of Mendelian principles 1.2 Linkage and crossing over: Linkage, linkage groups, types of crossing over, recombination maps in diploids for 3 point test cross, (determination of gene order with suitable examples)	
Unit2	Quantitative Genetics	2Lectures
	2.1 Inheritance of qualitative and quantitative traits: Polygenic traits and mode of inheritance, genetic and environmental factors 2.2 Heritability- broad sense and narrow sense(Russel)	
Unit3	Population Genetics	4 Lectures
	3.1 Principles of Population Genetics: Derivation of Hardy-Weinberg law and its application for autosomal genes. 3.2 Assortative mating, inbreeding and genetic drift	
Unit4	Clinical Genetics	6 Lectures
	4.1 Monogenetic diseases – Cystic Fibrosis, Tay-Sach's syndrome 4.2 – Inborn metabolic errors – Disorders of nucleic acid metabolism, lipid metabolism, Lysosomal storage diseases, Peroxisomal disorders	
Unit5	Applications of Molecular methodologies in genetic analysis	5Lectures
	5.1 Gene localization on chromosome 5.2 Chromosomal probes and paints 5.3 Gene Therapy – Ex-vivo and in-vivo gene therapy and examples of gene delivery systems	
Unit6	Human Genome Project	3 Lectures

Unit7	<i>Drosophila</i> Genetics – Genetic basis of sex determination and dosage compensation, Maternal genes, segmentation genes and homeotic gene functions.	5 Lectures
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P.G. Part 1 Master of Science SEM II
(2023 Course under NEP 2020)

Course Code: 23ScZooP212 Course Name: Physiology and Endocrinology

Teaching Scheme: TH 4Hours/Week Credit - 04C

Examination Scheme: CIA: 50Marks End-Sem: 50 Marks

Prerequisite:

Bachelor of Science

Course Objectives:

- To introduce detailed concepts in physiology.
- To learn comparative physiology in different animals.
- To introduce basic structure and function of different hormones
To learn significance, structures of different receptors and signalling pathways

Course Outcome:

On completion of the course the student will be able to:

- Understand the importance of concepts of physiology in different animals.
- Understand the importance and significance of physiological processes in mammals
- Understand the hormone - receptor interaction
- Know the different types of endocrine glands and their functions

Course Contents: Physiology

Unit 1	Digestion:	2Lectures
	1.1 Physiology of digestion and absorption.	
Unit2	Respiration:	4Lectures
	2.1 Respiratory surfaces: Comparison of ventilation associated with gills and pulmonary respiration. 2.2 Blood pigments: Role in oxygen transport, Oxygen dissociation curves and their physiological significances, Transport of CO ₂ .	
Unit3	Circulation:	4Lectures
	3.1 Cardiac cycle, Neurogenic and myogenic hearts,	

	3.2 Blood volume, cardiac out-put, ECG, peak abnormalities	
Unit4	Muscle contraction:	4Lectures
	4.1 Structure of the skeletal muscle, 4.2 Proteins of the myofilaments, actin-myosin interaction; sarcoplasmic reticulum and role of calcium in contraction.	
Unit5	Osmotic regulation:	3Lectures
	5.1 Osmolarity and tonicity, ionic regulation, hyper and hyposmotic regulators, 5.2 Ureosmotic animals.	
Unit6	Excretion:	4Lectures
	6.1 Basic processes in urine formation, Renal function in animals “Mammalian kidney”, Renal portal system, counter-current mechanism, disorders.	
Unit7	Temperature :	1Lecture
	7.1 Mechanism of thermoregulation in homeotherms and Poikilotherms	
Unit8	Chemical communication:	4Lectures
	8.1 Neuro-hemal and endocrine organs 8.2 Chemistry of vertebrate hormones 8.3 Mechanism of hormone action.	
Unit9	Sense organs:	5Lectures
	9.1 Classification of sense organs and their principles. 9.2 Detailed mechanism of photoreception 9.3 Types of reflexes and their functions 9.4 Principles of neural integration 9.5 Disorders	
Endocrinology		
Unit 1	Regulation by chemical messenger	4Lectures
	1.1 Types of regulatory molecules: Hormones, Neurotransmitters 1.2 Endocrine glands & hormones 1.3 Paracrine regulators	
Unit2	Hormone Receptor and Mechanism of Hormone Action	5Lectures
	2.1 Cell surface receptors, intracellular receptor 2.2 Receptor proteins & types of cell signaling 2.3 Signal Transduction cascade	
Unit3	Adenohypophysial and Neurohypophysial hormones	7 Lectures
	ACTH, PRL, STH and TSH, Osmoregulatory Hormones -ADH, Oxytocin; Mineralocorticoids-renin-angiotensin	
Unit4	Hormonal Regulation	5 Lectures
	4.1 Gastrointestinal hormones 4.2 Carbohydrates, protein and lipid metabolism 4.3 Pancreatic hormones glucocorticoids 4.4 Control of calcium and phosphate metabolism	

Unit5	Pituitary and hypothalamus	3Lectures
	5.1Control of chromatophore 5.2Hypothalmo- releasing hormone	
Unit6	Endocrine mechanism in crustacean	3 Lectures
	6.1 X and Y organs, 6.2Regulation of metabolism, heart, salt and water balance, reproduction, colour change, moulting	
Unit7	7.1 Hormones and reproduction in cephalopod mollusks and echinoderms	3 Lecture
	7.2 Hormones regulation in insect larval development and metamorphosis	

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P.G. Part 1 Master of Science SEM II
(2023 Course under NEP 2020)

Course Code : 23ScZooP213

Course Name : Practical Lab2

Teaching Scheme: TH 4Hours/Week

Credit - 04C

Examination Scheme: CIA : 50 Marks

End-Sem : 50Marks

Prerequisite Courses:

Bachelor of Science

Course Objectives:

- To understand basic Genetics, Molecular Biology, Physiology, Entomology and Biodiversity by actually performing related experiments
- To isolate and quantify genetic material of prokaryotic and eukaryotic cells.

Course Outcomes:

- The students will have an hands on training experience in Genetics, Molecular Biology, Physiology, Entomology and Biodiversity.
- Students shall be able to understand the insect systems in detail.

Sr. No.	Name of the Practical	No. of Practicals
	Genetics and Molecular Biology	
1.	Lab Safety Techniques and sterilization.	1P
2.	Isolation of bacterial DNA and estimation by UV spectrophotometry	1P
3.	Isolation of Liver/ Blood DNA	1P
4.	Quantification of DNA by Agarose gel electrophoresis	1P
5.	Absorption studies of isolated DNA	1P
6.	To analyse protein on native PAGE and SDS-polyacrylamide gel electrophoresis	2P
7	Polytene chromosomes of Drosophila or Chironomous-examination of puff and bands.	1P
8.	Pedigree Analysis: Sex-Linked, Autosomal dominant and recessive	1P
9.	Study of basic microbiology techniques	1P

10.	Bacterial growth curve	
	Physiology and Endocrinology	
11.	Body size and oxygen consumption in aquatic animals (crab/fish).	1P
12.	Study of nitrogenous waste products of animals from different habitats	1P
13.	RBCs in different vertebrates and in different physiological conditions.	1P
14.	Determination of bleeding and clotting time in human blood	1P
15.	Estimation of sugar in rat/crab/human blood	1P
16.	Determination of the heart beat in the crab-effect of temperature	1P
17.	Effect of eye stalk ablation on glucose in the haemolymph of the crab	1P
18.	Histology of invertebrate and vertebrate neurosecretory and endocrine structures	2P
	Basic Entomology and Biodiversity	
19.	Methods of collection, preservation and presentation of insects	2P
20.	Study of head capsules, mouth parts and antennae and their modification	1P
21.	Study of generalized wings and their modifications with significance	1P
22.	Study of beneficial insects and harmful insects	1P
23.	Dissection of cockroach for digestive and reproductive systems	1P
24.	Dissection of cockroach for reproductive systems	1P
25.	Study of biodiversity indices with example	1P
26.	Study of endangered fauna of Maharashtra	1P
27.	Supportive instruments in biodiversity assessment	1P
28.	Biodiversity study of fish, amphibian, reptiles, aves and mammals available in local area	1P
29.	Interpretation of ECG	1P

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PG Part 1 Year of M.Sc. (Zoology) SEM II
(2023 Course under NEP 2020)

Course Code : 23ScZooP214 Course Name : Basic Entomology and Biodiversity
Teaching Scheme: TH 2Hours/Week Credit - 02C
Examination Scheme: CIA : 25 Marks End-Sem : 25 Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To introduce basic entomology
- To learn origin, evolution and basic morphology of insects.
- To equip students with adequate knowledge of various biodiversity monitoring methodologies, conservation and management.
- The course is also focused to creating environmental awareness among learners.
- To make student understand the different causes of loss of biodiversity and the various ways to conserve it.

Course Outcomes:

On completion of the course, student will be have -

- Basic knowledge of entomology
- An idea about the typical morphological features of insect
- Evolutionary significance of insect
- To know about different types of insects and their different interactions with humans and other organisms
- Develop an ability to analyze, present and interpret wildlife conservation management information.
- Understand the importance of bio diversity and the consequences of bio diversity loss
- Know present status of wildlife of India and about rare and endangered species depicted in red data book.

Course Contents

Unit 1	Introduction to entomology	2Lectures
	1.1Definition and scope 1.2Origin of insects 1.3Evolution of Arthropods and inter-relationship of different classes 1.4Overview of common insect orders – General characters	
Unit 2	General morphology of Insect	3Lectures

	2.1 Head and its different appendages 2.2 Thorax and appendages 2.3 Abdomen and appendages	
Unit 3	General Anatomy of Insect	10 Lectures
	3.1 Brief outline of digestive system 3.2 Brief outline of Respiratory system 3.3 Brief outline of Circulatory system 3.4 Brief outline of Nervous system 3.5 Brief outline of Reproductive system 3.6 Brief outline of Excretory system 3.7 Brief outline of Endocrine system	
	Biodiversity	
Unit 1	Concept of biodiversity	1 Lecture
	4.1 Definition and Levels of biodiversity 4.2 Values of biodiversity: Consumptive, productive, social, ethical and option values	
Unit 2	Biodiversity distribution	2 Lectures
	2.1 Hotspot of biodiversity of world 2.2 Biogeographical classification of India 2.3 Endemism.	
Unit 3	Wildlife and its protection	2 Lectures
	3.1 Wildlife in India: value of wildlife and need for its conservation. 3.2 Conservation and protection act: Forest Conservation Act 1971, 1972, 1981, Wildlife Protection Act	
Unit 4	Threats to biodiversity	3 Lectures
	4.1 Loss of biodiversity and its causes 4.2 Listing of threatened biodiversity including vulnerable, rare, threatened, endangered and extinct. 4.3 Red data book and Blue data book	
Unit 5	Conservation of biodiversity	3 Lectures
	5.1 Strategies of conservation : Ex-situ and In-situ 5.2 Eco-development: objectives and implementation 5.3 Biodiversity mapping using GPS, GIS and remote sensing	
Unit 6	Case studies	2 Lectures
	6.1 Project tiger 6.2 Project elephant 6.3 Project rhino 6.4 Project crocodile	
Unit 7	Sustainable development and green technology	2 Lectures
	7.1 Sustainable Development, Brundlandt Report. Biosafety of GMOs and LMOs 7.2 International treaties and conventions. organizations, International efforts (Vienna Convention, Montreal Protocol 1987, UNFCCC, Kyoto Protocol, Earth Summit at Rio de Janeiro, 1992, Agenda-21, Convention on Biodiversity 1992.	

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P.G. Part I Year of M.Sc. Zoology SEM II
(2023 Course under NEP 2020)

Course Code : 23ScZooP221 Course Name: Biostatistics and Animal Biotechnology
Teaching Scheme: TH4Hours/Week Credit - 04C
Examination Scheme: CIA : 50Marks End-Sem : 50Marks
Course Objectives:

- To study basic biostatistics
- To study different processes of gene and animal cloning
- To study ethical aspects related to animal cloning

Course Outcomes:

On completion of the course, student will be able to–

- Apply different statistical tools by studying the data
- Design experiments related to gene cloning
- Understand importance of different genetically modified organisms and their applications.

Unit 1	Introduction	6 Lectures
	1.1 Applications and Uses of Statistics 1.2 Population and sample, Different types of Sample 1.3 Exercise and Problems.	
Unit 2	Data classification	3Lectures
	2.1 Some important terms (Class frequency, class- limits, Class-width, class –mark) 2.2 Frequency distribution, Cumulative frequency, Graphical representation of data (Histogram, Pie-Diagram, Ogive- Curve.) 2.3 Exercise & Problems.	
Unit 3	Measures of central tendency	3Lectures
	3.1 Concept of central tendency, Types of central tendency (Arithmetic mean, Median and mode) combined mean. 3.2 Partition values (Quartiles, Deciles, and Percentiles) 3.3 Exercise & Problems.	
Unit 4	Measures of Dispersion	3Lectures
	4.1 Concept of dispersion, absolute and relative measure of dispersion. 4.2 Different measures of dispersion (Range, Quartile- Deviation, Variance and standard-deviation, Coefficient of Variation) combined variance 4.3 Exercise & Problems.	

Unit 5	Correlation and Regression	3Lectures
	5.1 Bivariate data, concept of correlation, Types of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation and its properties. 5.2 Concept of regression, Linear regression, regression Coefficients and its properties. 5.3 Exercise & Problems.	
Unit 6	Probability	5Lectures
	6.1 Some important terms (types of experiment, sample Space and types of sample space, events and types of events.) 6.2 Definition of probability (mathematical and classical) Conditional probability. Concept of random variable Univariate probability Distribution and its mathematical expectation. 6.3 Some standard probability distributions (binomial, Poisson and normal) their probability distribution, mean, variance, and properties of these distribution . 6.4 Exercise & Problems.	
Unit 7	Test of Hypothesis	7Lectures
	7.1 Some important terms (hypothesis, types of hypothesis, Test, Critical region, acceptance region, type I error, type II error, level of significance, p- value) 7.2 Test for mean and equality of two population means, Test for proportion and equality of two population proportions. 7.3 chi-square test for goodness of fit, Unpaired and paired t test. F test for equality of two population variances. 7.4 Exercise & Problems.	

Unit 1	Animal cloning	7 Lectures
	Importance, Preparing DNA, Vector types – Fish, Pelement, Baculovirus vectors, Mammalian virus vectors, Different transfection methods, Transgene integration	
Unit 2	Detection of Transgenics and transgene function	4 Lectures
	Identification of Transgenic animals, Analysis of transgene integration, Detection of mRNA expression, Protein expression assays	

Unit 3	Expression of cloned proteins in Animal cells	3 Lectures
	Expression vectors, Overproduction of recombinant proteins, Downstream processing	
Unit 4	Transgenic animals	5 Lectures
	4.1 Transgenic mice as animal model and their applications, Transgenesis in other animals – cattles, fish sheep, Transgenic clone-Dolly 4.2 Position effects, Bioreactors 4.3 Pigs in xenotransplantation 4.4 Transgenic organisms to interrupt disease cycles – Transgenic snails, mosquitoes etc.	
Unit 5	Hybridoma technology	3 Lectures
	Somatic cell fusion, Production of monoclonal antibodies and its Applications	
Unit 6	Tissue engineering and modelling	3 Lectures
	6.1 Fundamentals and basic aspects of TE. 6.2 Basic aspects regarding artificial organs, embryonic and adult stem cells, Applications of stem cells	
Unit 7	Animal Husbandary	4 Lectures
	7.1 Overview of livestock breed 7.2 Artificial breeding – Methods of semen collection, insemination, cryopreservation of germ cells 7.3 IVF and embryo transfer	
Unit 8	Biosafety issues and Bioethics in Animal cloning	1 Lecture

References:

1. Principles And Practice of Biostatistics : Dr J.V. Dixit
2. . Statistical Methods: Snedecor G.W. & Cochran W.G.
3. Statistical Methods : Dixon W.S. and Massey
4. Robert Lanza et al. Essentials of Stem Cell Biology”, Academic Press, 2nd edition, 2006.USA
5. Text book of Animal Husbandary, 8th edition, (1998) G.C. Banerjee,Oxford and IBH Publishin co.Pvt. Ltd. India
6. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA
7. Gene Transfer to Animal Cells, 1st edition (2005), R. M. Twyman, Taylor & Francis USA.

Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune – 5
P.G. Part I Year of M.Sc. Zoology SEM II
(2023 Course under NEP 2020)

Course Code : 23ScZooP222 Course Name: Biostatistics and Medical Microbiology
Teaching Scheme: TH4Hours/Week Credit - 04C
Examination Scheme: CIA : 50Marks End-Sem : 50Marks
Course Objectives:

- To study basic biostatistics
- To study different microbes for their clinical significance

Course Outcomes:

On completion of the course, student will be able to–

- Apply different statistical tools by studying the data
- Understand the importance of different bacterial, fungal and viral organisms.
- Gain awareness of different bacterial, viral and fungal infections.

Unit 1	Introduction	6 Lectures
	1.1 Applications and Uses of Statistics 1.2 Population and sample, Different types of Sample 1.3 Exercise and Problems.	
Unit 2	Data classification	3Lectures
	2.1 Some important terms (Class frequency, class- limits, Class-width, class –mark) 2.2 Frequency distribution, Cumulative frequency, Graphical representation of data (Histogram, Pie-Diagram, Ogive- Curve.) 2.3 Exercise & Problems.	
Unit 3	Measures of central tendency	3Lectures
	3.1 Concept of central tendency, Types of central tendency (Arithmetic mean, Median and mode) combined mean. 3.2 Partition values (Quartiles, Deciles, and Percentiles) 3.3 Exercise & Problems.	
Unit 4	Measures of Dispersion	3Lectures
	4.1 Concept of dispersion, absolute and relative measure of dispersion. 4.2 Different measures of dispersion (Range, Quartile- Deviation, Variance and standard-deviation, Coefficient of Variation) combined variance 4.3 Exercise & Problems.	
Unit 5	Correlation and Regression	3Lectures
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	5.1 Bivariate data, concept of correlation, Types of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation and its properties. 5.2 Concept of regression, Linear regression, regression Coefficients and its properties. 5.3 Exercise & Problems.	
Unit 6	Probability	5 Lectures
	6.1 Some important terms (types of experiment, sample Space and types of sample space, events and types of events.) 6.2 Definition of probability (mathematical and classical) Conditional probability. Concept of random variable Univariate probability Distribution and its mathematical expectation. 6.3 Some standard probability distributions (binomial, Poisson and normal) their probability distribution, mean, variance, and properties of these distribution . 6.4 Exercise & Problems.	
Unit 7	Test of Hypothesis	7 Lectures
	7.1 Some important terms (hypothesis, types of hypothesis, Test, Critical region, acceptance region, type I error, type II error, level of significance, p- value) 7.2 Test for mean and equality of two population means, Test for proportion and equality of two population proportions. 7.3 chi-square test for goodness of fit, Unpaired and paired t test. F test for equality of two population variances. 7.4 Exercise & Problems.	

Medical Microbiology

Unit 1	Bacterial diseases with respect to causative agents, general characters, detection methods, therapeutic agents and prophylaxis. Handling and disposing of infectious material	13 Lectures
	a. Helicobacter pylori b. Campylobacter jejuni c. Mycobacterium tuberculosis d. Acinetobacter baumannii e. Actinomyces bovis/israelii	
Unit 2	Viral diseases with respect to causative agents, general characters, detection method, therapeutic agents and prophylaxis. Handling and	9 Lectures

	disposing of infectious material.	
	a. Hepatitis B b. H1N1 c. HIV d. Oncoviruses e. Ebola Virus	
Unit 3	Fungal diseases with respect to causative agents, general characters, detection methods, therapeutic agents and prophylaxis. Handling and disposing of infectious material	8 Lectures
	a. Candida albicans b. Trichophyton metagrophytes c. Aspergillus flavus	

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1. Asif M., Alvi I.A. and Rehman S.U. (2018) Insight into *Acinetobacter baumannii*: pathogenesis, global resistance, mechanisms of resistance, treatment options, and alternative modalities. *Infect Drug Resist.* 11:1249-1260.
2. Available from: <https://www.intechopen.com/books/mycobacterium-research-anddevelopment/virulence-factors-and-pathogenicity-of-mycobacterium>.
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13. Principles And Practice of Biostatistics : Dr J.V. Dixit
14. . Statistical Methods: Snedecor G.W. & Cochran W.G.
15. Statistical Methods : Dixon W.S. and Massey

