



R.E. Society's
**R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND
R.V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS),
RATNAGIRI**

NAAC accredited 'A' Grade (4th Cycle)
Ratnagiri-415612 (Maharashtra-India)

Bachelor of Science (B. Sc.) Programme

Program: S.Y.B. Sc.
Course: ZOOLOGY (MAJOR)

Syllabus for Semester III & IV

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2024-2025

PREAMBLE

Following the transformative vision outlined in the National Education Policy (NEP) of 2020, we are pleased to introduce the second-year B.Sc. course in Zoology Major, aligning with the principles and objectives set forth by NEP 2020. This course aims to provide students with a dynamic and holistic education that fosters practical skills, critical thinking, and a deep understanding of biological concepts.

The curriculum is designed to encompass a wide range of topics essential to the field of zoology, reflecting the interdisciplinary nature of modern biological sciences. With a focus on genetic fundamentals and chromosome dynamics, students will delve into the intricacies of heredity, molecular genetics, and chromosomal organization, laying the foundation for advanced studies in genetics and molecular biology.

Furthermore, the course explores the fundamental processes underlying life, including metabolism, growth, and reproduction, through the lens of Understanding Life Processes. Students will gain insight into the physiological mechanisms that govern living organisms, from single-celled organisms to complex multicellular organisms, fostering a comprehensive understanding of life's diversity and unity.

In addition to core concepts, the curriculum encompasses specialized areas of study such as Ethology, Parasitology, and Economic Zoology. Through Ethology, students will explore animal behavior and social interactions, gaining insight into the adaptive strategies and evolutionary dynamics that shape animal societies. Parasitology delves into the fascinating world of parasites and their interactions with host organisms, while Economic Zoology explores the practical applications of zoological knowledge in agriculture, conservation, and public health.

Complementing theoretical learning, Zoology Major Practical III provides hands-on experience and skill development in laboratory techniques, fieldwork, and data analysis. Students will engage in practical exercises related to genetic analysis, behavioural observations, parasite identification, and economic zoology applications, enhancing their proficiency in scientific methodology and experimentation.

Through this comprehensive curriculum, we endeavour to cultivate a cohort of zoologists equipped with the knowledge, skills, and ethical values necessary to address the challenges and opportunities of the 21st century. By embracing the principles of NEP 2020 and fostering a culture of innovation and inquiry, we aim to empower students to become leaders in the field of zoology and contribute meaningfully to scientific discovery and societal advancement.

**Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.**

OBJECTIVES

1. Develop a deep understanding of genetic fundamentals and chromosome dynamics, including the principles of Mendelian inheritance, molecular genetics, and chromosomal structure and function.
2. Explore the fundamental processes underlying life, such as metabolism, growth, and reproduction, to comprehend the diverse mechanisms by which organisms sustain life and propagate their species.
3. Investigate the complexities of animal behavior and social interactions through Ethology, aiming to elucidate the adaptive strategies, communication systems, and ecological roles of different animal species.
4. Gain insights into the fascinating world of parasites and their interactions with host organisms, fostering an understanding of parasite ecology, transmission dynamics, and host-parasite relationships in Parasitology.
5. Explore the practical applications of zoological knowledge in various sectors, including agriculture, conservation, and public health, through Economic Zoology, aiming to address real-world challenges and promote sustainable solutions.
6. Develop practical skills and proficiency in laboratory techniques, fieldwork, and data analysis through Zoology Major Practical III, enabling students to conduct scientific investigations, interpret experimental results, and communicate findings effectively.
7. Foster critical thinking, problem-solving abilities, and ethical values in scientific inquiry, encouraging students to approach biological questions with curiosity, rigor, and integrity.
8. Cultivate a sense of responsibility and stewardship towards the natural world, instilling in students a commitment to biodiversity conservation, environmental sustainability, and ethical treatment of animals.
9. Encourage interdisciplinary learning and collaboration, fostering connections between zoological concepts and other scientific disciplines, as well as societal issues and challenges.
10. Equip students with the knowledge, skills, and attitudes necessary for lifelong learning and professional growth, empowering them to pursue diverse career pathways in academia, research, industry, conservation, and healthcare.

STRUCTURE OF THE COURSE:**SEMESTER – III****MAJOR COURSES**

MAJOR COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTURES
USZOO301	Genetic fundamentals and Chromosome dynamics	1	Fundamentals of Genetics	2	30
		2	Chromosomes and Heredity		
		3	Nucleic Acids		
USZOO302	Understanding Life Processes	1	Nutrition and Excretion	2	30
		2	Respiration and Circulation		
		3	Control and Coordination, Locomotion and Reproduction		
USZOO303	Ethology, Parasitology, Economic Zoology	1	Ethology	2	30
		2	Parasitology		
		3	Economic Zoology		
USZOO304	Zoology Major Practical III			2	60

SEMESTER – IV**MAJOR COURSES**

MAJOR COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTURES
USZOO401	Population Genetics, Evolution and Research Methodology	1	Origin and Evolution of Life	2	30
		2	Population Genetics and Evolution		
		3	Scientific Attitude Methodology Scientific Writing and Ethics in Scientific Research		
USZOO402	Cell Biology and Biochemistry	1	Cell Biology	2	30
		2	Endomembrane System		
		3	Biomolecules		
USZOO403	Comparative Embryology, Human Reproduction and Environmental Impact	1	Comparative Embryology	2	30
		2	Aspects of Human Reproduction		
		3	Pollution and its effect on organisms		
USZOO404	Zoology Major Practical IV			2	60

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Genetic fundamentals and Chromosome dynamics	
Class	S. Y. B. Sc.	
Semester	III	
Course Code	USZOO301	
No. of Credits	2	
Nature	Theory	
Type	Major	
Course Outcomes:		
<p>CO1- The learner would comprehend and apply the principles of inheritance to study heredity.</p> <p>CO2 - The learner will understand the concept of multiple alleles, linkage and crossing over.</p> <p>CO3 - The learner will comprehend the structure of chromosomes and their types.</p> <p>CO4 - The learner will understand the mechanisms of sex determination.</p> <p>CO5- Learners would be able to correlate the disorders linked to a particular sex chromosome.</p> <p>CO6 - Learners will understand the importance of nucleic acids as genetic material.</p> <p>CO7 - Learners would comprehend and appreciate the regulation of gene expressions.</p> <p>Curriculum:</p>		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Fundamentals of Genetics	<p>1.1 Introduction to Genetics Definition, Scope, and Importance of Genetics Classical and Modern Concepts of Gene (Cistron, Muton, Recon) Explanation of Terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome.</p> <p>1.2 Mendelian Genetics (Part 1) Mendelian Genetics: Monohybrid & Dihybrid Cross Test Cross and Back Cross Mendel's Laws of Inheritance Mendelian Traits in Man</p> <p>1.3 Mendelian Genetics (Part 2) Exceptions to Mendelian Inheritance: Incomplete Dominance, Codominance, Lethal Genes Epistasis: Recessive, Double Recessive, Dominant, and</p>

		<p>Double Dominant Chromosome Theory of Inheritance</p> <p>1.4 Pedigree Analysis Autosomal Dominant and Recessive Traits X-Linked Dominant and Recessive Traits Pedigree Analysis Techniques</p> <p>1.5 Multiple Alleles and Multiple Genes Concept of Multiple Alleles Case Studies: Coat color in rabbits, ABO and Rh Blood Group System Polygenic Inheritance: Skin colour and Eye colour in humans Concept of Pleiotropy</p> <p>1.6 Linkage and Crossing Over Introduction to Linkage and Crossing Over Types of Crossing Over Cytological Basis of Crossing Over Experimental Evidence for Linkage and Crossing Over Mapping of Genes Using Crossing Over Data</p>
2.	Chromosomes and Heredity	<p>2.1 Chromosomes Types of Chromosomes–Autosomes and Sex chromosomes Chromosome structure - Heterochromatin, Euchromatin Classification based on the position of the centromere Endomitosis, Giant chromosomes- Polytene and Lampbrush chromosomes and Significance of Balbiani rings</p> <p>2.2 Sex-determination Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW Sex determination in Honey bees: Haplo-diploidy Sex determination in <i>Drosophila</i>- Genic balance theory, Intersex, Gynandromorphs Parthenogenesis Hormonal influence on sex determination-Freemartin and Sex reversal. Role of Environmental factors-<i>Bonellia</i> and Crocodile Barr bodies and Lyon hypothesis</p> <p>2.3 Sex-linked, sex influenced and sex-limited Inheritance. X-linked: Colour-blindness, Haemophilia Y-linked: Hypertrichosis Sex-influenced genes Sex-limited genes</p>

3.	Nucleic Acids	<p>3.1 Genetic material Griffith's transformation experiment, Avery-Macleod & McCarty experiment and Hershey Chase experiment of Bacteriophage infection. Chemical composition and structure of nucleic acids Double helix nature of DNA, Solenoid model of DNA Types of DNA– A, B, Z & H forms DNA in Prokaryotes- Chromosomal and Plasmid Extranuclear DNA-Mitochondria and Chloroplast RNA as a genetic material in the virus Types of RNA: Structure and function</p> <p>3.2 Genetic Information in a Eukaryotic Cell DNA Replication Transcription of mRNA Translation Genetic code</p> <p>3.3 Gene expression and regulation One gene-one enzyme hypothesis/one polypeptide hypothesis Concept of Operon, Lac Operon</p>
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Prescribed Text/s (If any):

1. Principles of Genetics. Gardner, E. J., Simmons, M.J and Snustad, D.P. John Wiley and Sons
- Concepts of Genetics. Klug, W. S., Cummings M.R., Spencer, C.A. Benjamin Cummings.
2. Genetics-A Molecular Approach. Russell, P.J. Benjamin Cummings.
3. Introduction to Genetic Analysis. Griffiths, A. J. F., Wessler. S.R., Lewontin, R.C. and Carroll, S. B. W. H. Freeman and Co.
4. Cell Biology Genetics, Molecular Biology Evolution and Ecology Verma P.S. and Agrawal 9th Edition, Chand Publications, New Delhi.
5. Principles of Genetics – Eight edition- Eldon John Gardner, Michael J. Simmons, D. Peter Snustad.
6. Genetics-Weaver, Hedrick, third edition, McGraw Hill Education.
7. Genetics A conceptual approach, Benjamin A. Pierce, Southwestern University, W.H. Freeman and Company, New York.
8. Genetics, Third Edition, Monroe W. Strickberger.

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Fundamentals of Genetics	Chalk and Talk, Interactive discussions, Power point presentations etc	10
2.	Chromosomes and Heredity	Chalk and Talk, Interactive discussions, Power point presentations etc.	10
3.	Nucleic Acids	Chalk and Talk, Interactive discussions, Power point presentations etc.	10

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Fundamentals of Genetics	Essay / short note (10 marks)	10
2.	2. Chromosomes and Heredity	Essay / short note (10 marks)	10
3.	3. Nucleic Acids	Essay / short note (10 marks)	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Understanding Life Processes	
Class	S. Y. B. Sc.	
Semester	III	
Course Code	USZOO302	
No. of Credits	2	
Nature	Theory	
Type	Major	
Course Outcomes:		
<p>CO1- The learner would understand the increasing complexity of nutritional, excretory and osmoregulatory physiology in the evolutionary hierarchy.</p> <p>CO2- The learner would be able to correlate the habit and habitat with nutritional, excretory and osmoregulatory structures.</p> <p>CO3- The learner would understand the increasing complexity of respiratory and circulatory physiology in the evolutionary hierarchy.</p> <p>CO4- The learner will be able to correlate the habits and habitat of animals with respiratory and Circulatory organs.</p> <p>CO5- The learner would understand the process of control and coordination by nervous and endocrine regulation.</p> <p>CO6- Learners would be amazed by various locomotory structures found in the animal kingdom.</p> <p>CO7- The learner would be acquainted with various reproductive strategies present in animals.</p>		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Nutrition and Excretion	<p>1.1 Comparative study of nutritional apparatus (structure and function): Amoeba, Hydra, Cockroach, Amphioxus, Pigeon, Ruminants</p> <p>1.2 Physiology of digestion in man.</p> <p>1.3 Comparative study of excretory and osmoregulatory structures and functions.</p> <p style="margin-left: 20px;">a) Amoeba-Contractile vacuole</p> <p style="margin-left: 20px;">b) Planaria-Flame cells</p> <p>1.4 Cockroach-Malpighian tubules Categorization of animals based on principle nitrogenous excretory Products</p> <p>1.5 Structure of kidney, uriniferous tubule and physiology of urine formation in man</p>

2.	Respiration and Circulation	<p>2.1 Comparative study of respiratory organs (structure and function) Earthworm, Spider, Any bony fish(Rohu / <i>Anabas</i> / <i>Clarius</i>), Frog and Pigeon.</p> <p>2.2 Structure of lungs and physiology of respiration in man</p> <p>2.3 Comparative study of circulation (a) Open and Closed type, (b) Single and Double type.</p> <p>2.4 Types of circulating fluids - Water, Coelomic fluid, Haemolymph, Lymph and Composition of Blood</p> <p>2.5 Comparative study of hearts (structure and function) Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon.</p> <p>2.6 Structure and mechanism of working of the heart in man.</p>
3.	Control and Coordination, Locomotion and Reproduction	<p>3.1 Control and coordination Irritability in <i>Paramecium</i>, nerve net in <i>Hydra</i>, nerve ring and nerve cord in earthworms. Types of neurons based on the structure and function. Conduction of nerve impulse: Resting potential, Action potential and Refractory period Synaptic transmission</p> <p>3.2 Movement and Locomotion Locomotory organs-structure and functions; a. Pseudopodia in Amoeba (Sol-Gel theory), Cilia in <i>Paramecium</i> b. Wings and legs in cockroach c. Tube feet in starfish d. Fins of fish</p> <p>3.3 Structure of striated muscle fibre in human and sliding filament theory</p> <p>3.4 Reproduction a. Asexual Reproduction- Fission, Fragmentation, Gemmule formation and Budding b. Sexual reproduction i. Gametogenesis ii. Structure of male and female gametes in human iii. Types of fertilization iv. Oviparity, Viviparity, Ovo-viviparity</p>
<p>Prescribed Text/s (If any):</p> <ol style="list-style-type: none"> 1. Vertebrate Zoology Volume I- Jordan and Verm, S. Chand and Co. 2. Invertebrate Zoology Volume II- Jordan and Verma, S. Chand and Co. 3. Invertebrate Zoology-Majupuria T.C., Nagin S. and Co. 4. Chordate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co. 5. Invertebrate Zoology-Dhami P. S. and Dhami J. K., R. Chand and Co. 6. Introduction to Vertebrates- Moore Cambridge University-Low Priced Edition. 7. Zoology-Miller S. A. and Harley J.B., Tata McGraw Hill. 8. Modern Textbook of Zoology, Invertebrates, Kotpal R.L 		

9. Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R., Cambridge University Press.

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Nutrition and Excretion	Chalk and Talk, Interactive discussions, PowerPoint presentations etc	10
2.	Respiration and Circulation	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10
3.	Control and Coordination, Locomotion and Reproduction	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Nutrition and Excretion	Essay / short note (10 marks)	10
2.	2. Respiration and Circulation	Essay / short note (10 marks)	10
3.	3. Control and Coordination, Locomotion and Reproduction	Essay / short note (10 marks)	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Ethology, Parasitology, Economic Zoology	
Class	S. Y. B. Sc.	
Semester	III	
Course Code	USZOO303	
No. of Credits	2	
Nature	Theory	
Type	Major	
Course Outcomes:		
<p>CO1- The learner would gain insight into different types of animal behaviour and their role in biological adaptations.</p> <p>CO2- Learners would be sensitized to the feelings which are instrumental in social behaviour.</p> <p>CO3-Learner would understand the general epidemiological aspects of parasites that affect humans and take simple preventive measures for the same.</p> <p>CO4- Learner would comprehend the life cycle of specific parasites, the symptoms of the disease and its treatment.</p> <p>CO5- The learner would gain knowledge on animals useful to mankind and the means to make the most of it.</p> <p>CO6- The learner would learn the modern techniques in animal husbandry and would pursue entrepreneurship as a career.</p>		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Ethology	<p>1.1 Definition and Scope of Ethology Introduction to the Study of Animal Behavior Historical Overview of Ethology Scope and Applications of Ethological Research</p> <p>1.2 Types of Animal Behavior Innate Behavior: Instincts and Fixed Action Patterns Learned Behavior: Habituation, Imprinting, Classical Conditioning Complex Learning: Instrumental Learning and Insight Learning</p> <p>1.3 Communication in Animals Vocal Communication: Calls, Songs, and Vocalizations Chemical Communication: Pheromones and Scent Marking Visual Communication: Body Language, Postures, and Displays</p> <p>1.4 Displacement Activities and Ritualization Displacement Behaviors: Redirected Actions During</p>

		<p>Conflicting Situations Ritualization of Behavior: Development of Stereotyped Signals and Displays Function and Significance of Displacement and Ritualized Behaviors</p> <p>1.5 Social Behavior in Primates Hanuman Langur: Social Structure, Communication, and Reproductive Strategies Comparative Studies of Primate Social Systems: Chimpanzees, Bonobos, and Gorillas Insights into Human Evolution and Social Behavior from Primate Studies</p> <p>1.6 Elements of Socio-biology: Altruistic Behavior: Selfless Acts and Cooperation Among Group Members Kin Selection Theory: Genetic Relatedness and Altruistic Behaviors Applications of Socio-biology in Understanding Social Structures and Group Dynamics</p>
2.	Parasitology	<p>2.1 Introduction to Parasitology and Types of Parasites Definitions: Parasitism, Host, Parasite, Vector-biological and mechanical Types of parasites- Ectoparasite, Endoparasite and their subtypes Parasitic adaptations in Ectoparasites and Endoparasites Types of hosts: Intermediate and definitive, reservoir</p> <p>2.2 Host-parasite relationship and host specificity Different types of hosts- parasite relationships, structural specificity, physiological specificity and ecological specificity</p> <p>2.3 Lifecycle, pathogenicity, control measures and treatment <i>Entamoeba histolytica, Fasciola hepatica, Taenia solium, Wuchereria bancrofti</i></p> <p>2.4 Morphology, life cycle, pathogenicity, control measures and treatment Head louse (<i>Pediculus humanus capittis</i>), Mite (<i>Sarcoptes scabiei</i>), Bedbug (<i>Cimex lectularis</i>)</p> <p>2.5 Parasitological significance Zoonosis-Bird flu, Anthrax, Rabies and Toxoplasmosis</p>
3.	Economic Zoology	<p>3.1 Introduction to Economic Zoology Definition and Scope of Economic Zoology Importance of Economic Zoology in Agriculture, Industry and Public Health</p> <p>3.2 Sericulture Introduction to Sericulture: History, Importance, and Silk Production Regions Silkworm Rearing Techniques: Mulberry Cultivation,</p>

		<p>Cocoon Production, and Silk Reeling Economic Importance of Silk: Silk Industry, Trade, and Export Markets</p> <p>3.3 Apiculture Overview of Apiculture: Beekeeping Practices and Management Products of Beekeeping: Honey, Beeswax, Propolis, Pollen and Royal Jelly Economic Significance of Bees: Pollination Services, Honey Production, and Hive Products</p> <p>3.4 Vermiculture Vermicomposting Techniques: Earthworm Rearing, Feedstock Preparation, and Vermicompost Production Applications of Vermiculture: Soil Fertility Improvement, Organic Waste Management, and Sustainable Agriculture Economic Opportunities in Vermiculture: Market Demand for Vermicompost, Earthworm Sales, and Entrepreneurship</p> <p>3.5 Poultry Farming Poultry Breeds and Management Practices: Broilers, Layers, and Dual-Purpose Breeds Egg and Meat Production: Housing, Feeding, and Disease Management Economic Contributions of Poultry Farming to Food Production and Livelihoods</p>
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Prescribed Text/s (If any):

1. Animal Behaviour-David McFarland
2. Animal Behaviour-Mohan Arora
3. Animal Behaviour- Reena Mathur
4. Animal Behaviour-Tinbergen
5. Bee and Bee Keeping- Roger A. Morse, Cornell University Press London
6. Vermiculture Technology- Clive A. Edwards, Norman Q. Arancon and Rhonda Sherman
7. Parasitology-Chatterjee K.D., Chatterjee Medical Publishers.
8. Medical Parasitology- Arora
9. Essentials of Parasitology-Gerald D. Schmidt: Universal Bookstall, New Delhi.
10. Economic Zoology Biostatistics and Animal behaviour –S. Mathur, Rastogi Publications.
11. Economic Zoology-Shukla G.S. & Upadhyay V. B., Rastogi Publications.
12. A handbook on Economic Zoology, S. Chand& Co.

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Ethology	Chalk and Talk, Interactive discussions, PowerPoint presentations etc	10
2.	Parasitology	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10

3.	Economic Zoology	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10
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Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Ethology	Essay / short note (10 marks)	10
2.	2. Parasitology	Essay / short note (10 marks)	10
3.	3. Economic Zoology	Essay / short note (10 marks)	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Zoology Major Practical
Class	S. Y. B. Sc.
Semester	III
Course Code	USZOO304
No. of Credits	2
Nature	Practical
Type	Major

Practical - I		
1	Extraction and Detection of DNA	1 Credit
2	Extraction and Detection of RNA	
3	Mounting of Barr Bodies	
4	Study of Polytene Chromosomes	
5	Study of Mitosis: Temporary Squash Preparation of Onion Root Tip	
6	Detection of Blood Groups and Rh Factor	
7	Problems in Genetics: a) Monohybrid/Dihybrid Cross b) X-linked Inheritance c) Multiple Alleles	
8	Problems Based on Molecular Biology	
9	Problems based on Chromosome mapping.	
10	Maintenance of Drosophila Culture: Identifying Male and Female Flies, and Different Larval Stages	

Practical -II		
1.	To study nests and nesting habits of the birds and social insects.	1 Credit
2.	Study of Protozoan parasites: a. Trypanosoma gambiense b. Giardia intestinalis Study of Helminth parasites: a. Ancylostoma duodenale b. Dracunculus medinensis	
3.	Study of different types of bees (Queens, Drones and Worker bees).	
4.	Study of different types of silk moths.	
5.	Identification of various types of natural silks.	

6	Extraction of casein from milk and its qualitative estimation.	
7	Preparation of paneer from the given milk sample.	
8	Measurement of density of milk using different samples by Lactometer.	
9	Study of circadian functions in humans (daily eating, sleep and temperature patterns).	
10	Project- Suggested topics on economic zoology (e.g. Apiculture / Sericulture/Lac culture/ Vermicompost technique / Construction Of artificial beehives/Animal husbandry/ Aquaculture /any other)	

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(viva voce, report submission, journal, active participation in lab work and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	-	Experiment 1	10
2.	-	Experiment 2	10
3.	-	Experiment 3	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Population Genetics, Evolution and Research Methodology	
Class	S.Y. B. Sc.	
Semester	IV	
Course Code	USZOO401	
No. of Credits	2	
Nature	Theory	
Type	Major	
Course Outcomes:		
CO1-Learner will gain insights into the origin of life.		
CO2-Learner will analyse and critically view the different theories of evolution.		
CO3-Learner would understand the forces that cause evolutionary changes in natural populations		
CO4- Learner would comprehend the mechanisms of speciation		
CO5- The learner will be able to distinguish between microevolution, macroevolution and Mega evolution		
CO6- The learner would develop qualities such as critical thinking and analysis,		
CO7-The learner will imbibe the skills of scientific communication and he/she will understand the ethical aspects of research		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Origin and Evolution of Life	1.1 Introduction Origin of the Universe Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory Origin of life Origin of eukaryotic cell 1.2 Evidence in favour of organic evolution Evidence from geographical distribution, palaeontology, anatomy, embryology, physiology and genetics 1.3 Theories of organic evolution Theory of Lamarck Theory of Darwin and Neo-Darwinism Mutation Theory Modern synthetic theory, Weismann's Germplasm theory
2.	Population Genetics and Evolution	2.1 Introduction to Population Genetics Definition Brief explanation of the following terms: Population, Gene pool, Allele frequency, Genotype

		<p>frequency, Phenotype frequency, Microevolution</p> <p>2.2 Population genetics Hardy-Weinberg Law Factors that disrupt Hardy Weinberg equilibrium: Mutation, Migration (gene flow), Non-random mating (inbreeding, inbreeding depression, assortative mating (positive and negative), disassortative mating, Genetic drift (sampling error, fixation, bottleneck effect and founder effect) Natural Selection: Patterns of Natural Selection- Stabilizing selection, Directional selection (examples: pepper red moth, antibiotic resistance in bacteria, pesticide resistance) and Disruptive selection</p> <p>2.3 Evolutionary genetics Genetic variation: Genetic basis of variation- mutations and recombination (crossing over during meiosis, independent assortment of chromosomes during meiosis and random union of gametes during fertilization) Nature of genetic variations: Genetic polymorphism, Balanced polymorphism, Mechanisms that preserve balanced polymorphism- Heterozygote advantage and frequency-dependent selection, Neutral variations Geographic variation (Cline) Species concept: Biological species concept and evolutionary species Concept Speciation and Isolating mechanisms: Definition and modes of speciation (allopatric, sympatric, parapatric and peripatric) Geographical isolation Reproductive isolation and its isolating mechanisms (prezygotic and postzygotic)</p> <p>2.4 Macroevolution and mega evolution: Concept and Patterns of macroevolution (stasis, preadaptation/exaptation, mass extinctions, Adaptive radiation and coevolution), Mega evolution</p>
3.	Scientific Attitude Methodology Scientific Writing and Ethics in Scientific Research	<p>Process of science: A dynamic approach to investigation: The Scientific method, Deductive reasoning and inductive reasoning, Critical thinking, Role of chance in scientific discovery (serendipity) Scientific research: Definition, difference between method and methodology, characteristics, types Steps in the Scientific method: Identification of research problem, formulation of research hypothesis, testing the hypothesis using Experiments or surveys, preparing research/study Design including methodology and execution</p>

		<p>(appropriate controls, sample size, technically sound, free from bias, repeat experiments for consistency), documentation of data, data analysis and interpretation, results and conclusions.</p> <p>Dissemination of data: Reporting results to scientific community (publication in peer- reviewed journals, thesis, dissertation, reports, oral presentation, poster presentation)</p> <p>Application of knowledge: Basic research, Applied research and Translational research</p> <p>3. 2 Scientific writing: Structure and components of a research paper: preparation of manuscript for publication of research paper- title, authors and their affiliations, abstract, keywords and abbreviations, introduction, material and methods, results, discussion, conclusions, acknowledgement, bibliography; figures, tables and their legends</p> <p>3. 3 Writing a review paper Structure and components of the review Report writing and types of report Computer application: Plotting of graphs, Statistical analysis of data. Internet and its application in the research-Literature survey, Online submission of the manuscript for publication.</p> <p>3.4 Ethics Ethics in animal research: The ethical and sensitive care and use of animals in research, teaching and testing, approval from the Dissection Monitoring Committee (DMC) Ethics in clinical research: Approval from clinical research ethics Committee or/and informed consent</p> <p>3.5 Plagiarism</p>
<p>Prescribed Text/s (If any):</p> <ol style="list-style-type: none"> 1. Theory of Evolution-Smith, Cambridge Press, and Low-price Ed. 2. Evolution-Strickberger, CBS publication 3. Evolution-P.S. Verma and Agarwal 4. Biology. E. P. Solomon, L.R. Berg, D. W. Martin, Thompson Brooks/Cole 5. Biology -The Unity and Diversity of Life. C. Starr, R. Taggart, C. Evers, L. Starr, Brooks/Cole Cengage Learning International Edition 6. Research Methodology, Methods and Techniques-by C. R. Kothari, Wiley Eastern Ltd. Mumbai 7. Practical research planning and design 2nd edition-Paul D Leedy, Macmillan Publication <p>Other Learning Resources recommended:</p>		

Teaching Plan:			
Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Origin and Evolution of Life	Chalk and Talk, Interactive discussions, PowerPoint presentations etc	10
2.	Population Genetics and Evolution	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10
3.	Scientific Attitude Methodology Scientific Writing and Ethics in Scientific Research	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10

Evaluation Pattern

C) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

D) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Origin and Evolution of Life	Essay / short note (10 marks)	10
2.	2. Population Genetics and Evolution	Essay / short note (10 marks)	10
3.	3. Scientific Attitude Methodology Scientific Writing and Ethics in Scientific Research	Essay / short note (10 marks)	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Cell Biology and Biochemistry	
Class	S. Y. B. Sc.	
Semester	IV	
Course Code	USZOO402	
No. of Credits	2	
Nature	Theory	
Type	Major	
Course Outcomes:		
CO1- The learner would acquire insight into the composition of the transport mechanisms adopted by the cell and its organelles for its maintenance and composition of the cell.		
CO2- The learner would appreciate the intricacy of the endomembrane system.		
CO3-Learner would understand the interlinking of the endomembrane system for functioning of the cell		
CO4- The learner will realize the importance of biomolecules and their clinical significance.		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Cell Biology	<p>1.1 Introduction to cell biology Definition and scope Cell theory Generalized prokaryotic, eukaryotic cell: size, shape and structure</p> <p>1.2 Nucleus Size, shape, number and position Structure and functions of the interphase nucleus Ultrastructure of the nuclear membrane and pore complex Nucleolus: general organization, chemical composition & functions Nuclear sap/ nuclear matrix Nucleocytoplasmic interactions</p> <p>1.3 Plasma membrane Fluid Mosaic Model Junctional complexes Membrane receptors Modifications: Microvilli and Desmosomes</p> <p>1.4 Transport across membrane Diffusion and Osmosis Transport: Passive and Active Endocytosis and Exocytosis</p>

		<p>1.5 Cytoskeletal structures Microtubules: Composition and functions Microfilaments: Composition and functions</p>
2.	Endomembrane System	<p>2.1 Endoplasmic reticulum (ER): General morphology of endomembrane system, ultrastructure, types of ER and biogenesis of ER Functions of Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER)</p> <p>2.2 Golgi complex: Ultrastructure of Golgi complex, functions of Golgi complex (protein glycosylation, lipid and polysaccharide metabolism, protein sorting and secretion, Golgi Anti-Apoptotic Protein -GAAP)</p> <p>2.3 Lysosomes: Origin, occurrence, polymorphism and functions; Peroxisomes: Origin, morphology & functions</p> <p>2.4 Mitochondria: Ultrastructure, chemical composition, functions of mitochondria and bioenergetics (Chemical energy & ATP, Krebs' cycle, respiratory chain and oxidative phosphorylation)</p>
3.	Biomolecules	<p>Biomolecules: Concept of micromolecules and macromolecules</p> <p>3.2 Carbohydrates: Definition classification, properties and isomerism, glycosidic bond Structure of Monosaccharides (glucose and fructose); Oligosaccharides (lactose and sucrose); Polysaccharides (cellulose, starch, glycogen and chitin) Biological role and clinical significance.</p> <p>3.3 Amino Acids and Proteins: Basic structure, classification of amino acids, Essential and Non-essential amino acids, Peptide bonds, Protein conformation: Primary, Secondary, Tertiary, Quaternary Types of proteins–Structural (collagen)and functional proteins (haemoglobin) Biological role and clinical significance.</p> <p>3.4 Lipids: Definition, and classification of lipids with examples, ester linkage Physical and chemical properties of lipids. Saturated and unsaturated fatty acids Essential fatty acids; Triacylglycerols; Phospholipids (lecithin and cephalin); Steroids (cholesterol)</p> <p>3.5 Biological role and clinical significance Vitamins:</p>

		Water-soluble vitamins (e.g., Vit. C, Vit. B12) Lipid soluble vitamins (e.g., Vit A, Vit D) Biological role and clinical significance
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Prescribed Text/s (If any):

1. Cell Biology, Singh and Tomar, Rastogi Publication.
2. Cell and Molecular Biology, E.D.P De Robertis and E.M.R Robertis, CBS Publishers and Distributors.
3. The cell, A molecular approach, Geoffrey M. Coper ASM Press Washington D.C.
4. A textbook of cytology M. Suruchi Tyagi Dominant Publishers and Distributors New Delhi.
5. Cell and molecular biology, Gupta P. K., Rastogi Publication, India.
6. Cell Biology, Pawar C.B. Himalaya publication
7. Molecular Biology of the cell, (6thed) by the Inertus
8. Principles of Biochemistry, 2005, 2nd and 3rd edn. Lehninger A.L. Nelson D.L. and Cox M.M.
9. Biochemistry, Dushyant Kumar Sharma, 2010, Narosa Publishing house PVT.Ltd.
10. A Textbook of Biochemistry, 9thedition, Dr. Rama Rao A.V.S.S and Dr A Suryalakshmi.
11. Biochemistry- G Zubay, Addison Wesley, 1983
12. Biochemistry, L Stryer, 3rd/4th/5th ed, 1989, Freeman and Co. NY

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Cell Biology	Chalk and Talk, Interactive discussions, PowerPoint presentations etc	10
2.	Endomembrane System	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10
3.	Biomolecules	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Cell Biology	Essay / short note (10 marks)	10
2.	2. Endomembrane System	Essay / short note (10 marks)	10
3.	3. Biomolecules	Essay / short note (10 marks)	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Comparative Embryology, Aspects of Human Reproduction, Pollution and its effect on organisms	
Class	S. Y. B. Sc.	
Semester	IV	
Course Code	USZOO403	
No. of Credits	2	
Nature	Theory	
Type	Major	
Course Outcomes:		
CO1- The learner will be able to understand and compare the different types of eggs and sperm. CO2- The learner will be able to understand and compare the different pre-embryonic stages. CO3- Learners will be able to understand human reproductive physiology. CO4- Learners will become familiar with advances in ART and related ethical issues. CO5- The learners will be sensitized about the adverse effects of pollution and measures to control		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Comparative Embryology	1.1 Types of Eggs- Based on amount and distribution of yolk 1.2 Structure and Types of Sperm 1.3 Types of Cleavages 1.4 Types of Blastulae 1.5 Types of Gastrulae 1.6 Coelom -Formation and types
2.	Aspects of Human Reproduction	2.1 Human reproductive system and hormonal regulation Anatomy of human male and female reproductive system Hormonal regulation of reproduction and impact of age on reproduction - menopause and andropause 2.2 Contraception & birth control Difference between contraception and birth control Natural Methods: Abstinence, rhythm method, temperature method, cervical mucus or Billings method, coitus interruptus, lactation amenorrhea Artificial methods: Barrier methods, hormonal methods, intrauterine contraceptives, sterilization, termination, Abortion 2.3 Infertility Female infertility:

		<p>Causes - Failure to ovulate; production of infertile eggs; damage to oviducts (oviduct scarring and Pelvic inflammatory disease -PID, TB of oviduct), Uterus (TB of uterus and cervix)</p> <p>Infertility-associated disorders – Endometriosis, Polycystic Ovarian Syndrome (PCOS), Primary ovarian failure (POF), Sexually Transmitted Infections (STIs) - gonorrhoea, chlamydia, syphilis and genital herpes; Antibodies to sperm; Genetic causes-recurrent abortions</p> <p>Role of endocrine disruptors</p> <p>2.4 Treatment of infertility Removal /reduction of causative environmental factors Surgical treatment Hormonal treatment- fertility drugs Assisted Reproductive Technology (ART) - In vitro fertilization (IVF); Embryo transfer (ET); Intra-Fallopian transfer (IFT), Gamete Intra-Fallopian Transfer (GIFT) & Intra-Zygote Transfer (ZIFT); Intra-cytoplasmic Sperm Injection (ICSI) with ejaculated sperm and sperm retrieved from testicular biopsies; Testicular sperm extraction (TESE). Sperm bank, cryopreservation of gametes and embryos Surrogacy</p>
3.	Pollution and its effect on organisms	<p>3.1 Air Pollution Types and sources of air pollutants Effects of air pollution on organisms, its control and abatement measures</p> <p>3.2 Water Pollution Types and sources of water pollutants Effects of water pollution on organisms, its control and abatement measures</p> <p>3.3 Soil Pollution Types and sources of soil pollutants Effects of soil pollution on organisms, its control and abatement measures</p> <p>3.4 Sound pollution Different sources of sound pollution Effects of sound pollution on organisms, its control and abatement measures</p> <p>Pollution by radioactive substances</p> <p>3.6 Pollution by solid wastes Types and sources, Effects of solid waste pollution, its control and abatement measures</p> <p>Pollution – Climate Change and Global Warming</p>

Prescribed Text/s (If any):

1. Developmental Biology-5th Edition, Scot F. Gilbert, Sinauer Associates Inc.
2. Developmental Biology-Subramoniam T., Narosa Publishers.
3. Developmental Biology-Berril N. J., Tata McGraw-Hill Publication.
4. Essential Reproduction-Martin H. Johnson, Wiley-Blackwell Publication.
5. Chick Embryology-Bradley M. Pattern.
6. Embryology-Mohan P. Arora.
7. Chordate Embryology-Dalela, Verma and Tyagi.
8. Human Anatomy and Physiology. E. L. Marie, Pearson Education Low Price Edition.
9. Biological Science. Taylor, Green and Stout. Cambridge Publication.
10. Biology. E. P. Solomon, L.R. Berg, D. W. Martin, Thompson Brooks/Cole.

Other Learning Resources recommended:**Teaching Plan:**

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Comparative Embryology	Chalk and Talk, Interactive discussions, PowerPoint presentations etc	10
2.	Aspects of Human Reproduction	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10
3.	Pollution and its effect on organisms	Chalk and Talk, Interactive discussions, PowerPoint presentations etc.	10

Evaluation Pattern**A) Continuous Internal Evaluation: Maximum Marks:20**

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Comparative Embryology	Essay / short note (10 marks)	10
2.	2. Aspects of Human Reproduction	Essay / short note (10 marks)	10
3.	3. Pollution and its effect on organisms	Essay / short note (10 marks)	10

Syllabus for Second Year Bachelor of Science in Zoology for the year 2024-25

Nomenclature of the Course	Zoology Major Practical
Class	S. Y. B. Sc.
Semester	IV
Course Code	USZOO404
No. of Credits	2
Nature	Practical
Type	Major

Practical -I		
1.	Study of population density by line transect method & Quadrant method and calculate different diversity indices. <ul style="list-style-type: none"> • Index of Dominance • Index of frequency • Rarity Index • Shannon Index • Index of species diversity 	1 Credit
2.	Study of prokaryotic cells (bacteria) by Crystal violet staining technique.	
3.	Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain	
4.	Qualitative Tests for Carbohydrates: Perform Molisch's test, Benedict's test, Barfoed's test, and Anthrone test to detect carbohydrates qualitatively.	
5.	Qualitative Tests for Protein: Conduct Ninhydrin test, Biuret test, Millon's test, and Xanthoproteic test to identify proteins qualitatively.	
6.	Qualitative Test for Lipids: Perform Solubility test and Sudan III test to detect lipids qualitatively.	
7.	Study of Rancidity of Lipids: Investigate the rancidity of lipids using the titrimetric method.	
8.	Learn to compile bibliographies and write abstracts for research papers.	
9.	Create a PowerPoint presentation based on a selected research paper in the field of biological sciences.	
10.	Report submission on 'Current issues in Biological sciences'	

Practical - II		1 Credit
1.	Study of permeability of cell through plasma membrane (osmosis in blood cells).	
2.	Measurement of cell diameter by oculomotor (by using permanent slide)	
3.	Detection of pregnancy from a given sample of urine.	
4.	Study of birth control measures applicable to humans–IUD, condom and hormonal pills.	
5.	Study of the following permanent slides, museum specimens and materials	
6.	Learn about and operate a sound pollution monitoring device to assess environmental noise levels.	
7.	Study of clinical disorders due to carbohydrates, proteins and lipid imbalance (Photograph to be provided / symptoms to be given and disorder to be identified): Hyperglycemia, Hypoglycemia, Anemia, Kwashiorkor, Marasmus and Fatty Liver	
8.	Estimate dissolved oxygen and salinity levels in water samples using a refractometer and conductometer, respectively.	
9.	Measure physical properties (temperature, moisture, texture) and chemical properties (pH, organic matter) of soil samples.	
10.	Study of the natural ecosystem and field report of the visit.	

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(viva voce, report submission, active participation in lab work and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	-	Experiment 1	10
2.	-	Experiment 2	10
3.	-	Experiment 3	10

Date:

Place: Ratnagiri



**Signature
Chairperson and HoD**



R.E. Society's

**R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND
R.V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS),
RATNAGIRI**

NAAC accredited 'A' Grade (4th Cycle)
Ratnagiri-415612 (Maharashtra-India)

**SYLLABUS FOR
S. Y. B. Sc.**

ZOOLOGY (MINOR)

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2024-2025

PREAMBLE:

We are thrilled to introduce two exciting courses, Aquatic Biology and Evolutionary Biology, as part of the Zoology minor for Second-Year B.Sc. Students are set to be implemented from the academic year 2024-2025. These courses offer an enriching exploration into two captivating branches of biology, providing students with a comprehensive understanding of aquatic ecosystems and the mechanisms driving evolutionary change.

Aquatic ecosystems, encompassing freshwater and marine environments, are teeming with diverse life forms and play a vital role in sustaining life on Earth. Understanding the biology of aquatic organisms and the dynamics of aquatic ecosystems is essential for addressing pressing environmental challenges and preserving biodiversity. Meanwhile, Evolutionary Biology delves into the fascinating mechanisms that drive the diversity of life on our planet, offering insights into the processes of adaptation, speciation, and genetic variation.

Through these courses, students will delve into the fundamental principles of Aquatic Biology and Evolutionary Biology, exploring the anatomy, physiology, ecology, and evolutionary history of organisms. They will examine the unique adaptations of aquatic organisms to their environments, the ecological interactions shaping aquatic ecosystems, and the mechanisms of evolutionary change driving biodiversity.

As we embark on this educational journey, let us embrace the wonders of aquatic and evolutionary biology with curiosity, enthusiasm, and a commitment to scientific inquiry. Together, we will unravel the mysteries of life in aquatic environments and gain insights into the mechanisms driving the diversity of life forms on Earth.

**Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.**

OBJECTIVES:

Aquatic Biology:

1. Introduce students to the diversity of aquatic ecosystems, including freshwater and marine environments.
2. Explore the anatomy, physiology, and life history strategies of key aquatic organisms, such as fish, invertebrates, and algae.
3. Examine the ecological principles governing aquatic ecosystems, including nutrient cycling, trophic interactions, and biodiversity dynamics.
4. Investigate the impact of human activities on aquatic environments, including pollution, habitat destruction, and climate change.
5. Discuss conservation strategies aimed at preserving and restoring aquatic biodiversity and ecosystem health.
6. Engage in hands-on activities, fieldwork, and laboratory experiments to explore aquatic organisms and ecosystems.
7. Encourage collaborative learning and peer interaction through group projects, discussions, and presentations.

Evolutionary Biology:

1. Introduce students to the fundamental principles of evolutionary biology, including natural selection, genetic variation, and speciation.
2. Explore the mechanisms driving evolutionary change, including mutation, genetic drift, and gene flow.
3. Examine the evidence for evolution from various fields, including palaeontology, comparative anatomy, and molecular biology.
4. Investigate the evolutionary history of major taxa, including plants, animals, and microorganisms.
5. Discuss the role of evolutionary processes in shaping biodiversity and ecological communities.
6. Explore current research topics and debates in evolutionary biology, including evolutionary medicine and conservation genetics.
7. Engage in hands-on activities and laboratory experiments to explore evolutionary concepts and processes.
8. Encourage collaborative learning and peer interaction through group projects, discussions, and presentations.

STRUCTURE OF THE COURSE:

SEMESTER – III

MINOR COURSES - AQUATIC BIOLOGY

MINOR COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTURES
USZOO305	Aquatic Biology	1	Introduction to Aquatic Ecosystems	2	30
		2	Aquatic Organisms		
		3	Human Impacts on Aquatic Ecosystems		
USZOO306	Zoology Minor Practical III			2	60

SEMESTER – IV

MINOR COURSES – EVOLUTIONARY BIOLOGY

MINOR COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTURES
USZOO405	Evolutionary Biology	1	Origin of Life and evidences of Evolution	2	30
		2	Evolutionary forces		
		3	Origin and evolution of man		
USZOO406	Zoology Minor Practical IV			2	60

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Aquatic Biology
Class	S. Y. B. Sc.
Semester	III
Course Code	USZOO305
No. of Credits	2
Nature	Theory
Type	Minor

Course Outcomes:

- CO1: Learners will understand and apply relevant scientific principles in the field of aquatic biology.
- CO2: Learners will employ scientific methodologies, including experimentation and data analysis, in the study of aquatic biology.
- CO3: Learners will critically analyze, interpret, and evaluate information pertinent to aquatic biology.
- CO4: Learners will appreciate the multidisciplinary nature of aquatic biology and engage constructively with diverse perspectives and ideas.
- CO5: Learners will explore unique environmental challenges associated with aquatic ecosystems.
- CO6: Learners will develop practical skills for analyzing freshwater biological water quality, enhancing employability in relevant fields.

Syllabus:

Unit No.	Unit Title	Subtitles (Learning Points)
1.	Introduction to Aquatic Ecosystems	1.1 Overview of Aquatic Environments Exploring the Diversity of Aquatic Habitats Understanding the Scope of Aquatic Environments Dynamics of Aquatic Systems: An Overview 1.2 Classification and Types of Aquatic Ecosystems Categorizing Aquatic Environments: A Taxonomic Approach Types of Freshwater Ecosystems: Lakes, Rivers, Wetlands, and More The Diversity of Marine Ecosystems: Oceans, Coral Reefs, and Estuaries 1.3 Importance of Aquatic Ecosystems Ecological Significance of Aquatic Environments Economic Value of Aquatic Resources Cultural and Recreational Importance of Water Bodies 1.4 Physical and Chemical Characteristics of Aquatic Environments The Unique Properties of Water: Cohesion, Adhesion, and Surface Tension Temperature, Light, and Depth: Factors Shaping

		<p>Aquatic Conditions</p> <p>Chemical Composition of Aquatic Systems: pH, Dissolved Oxygen, and Nutrient Levels</p>
2.	Aquatic Organisms	<p>2.1 Diversity of Aquatic Life Forms</p> <p>Exploring the Richness of Aquatic Species</p> <p>Taxonomic Diversity: Microbes, Plants, and Animals</p> <p>Hotspots of Biodiversity: Coral Reefs, Mangroves, and Deep-sea Ecosystems</p> <p>2.2 Adaptations of Aquatic Organisms</p> <p>Survival Strategies in Aquatic Habitats: Morphological and Physiological Adaptations</p> <p>Adaptation of Hill-Stream Fishes</p> <p>Adaptation of Deep-Sea Organisms</p> <p>Behavioural Adaptations: Feeding, Reproduction, and Defence Mechanisms</p> <p>2.3 Physiological Adaptations of Aquatic Organisms</p> <p>Feeding Strategies in Aquatic Organisms</p> <p>Respiration Mechanisms in Aquatic Environments</p> <p>Osmoregulation in Freshwater and Marine Organisms</p> <p>2.4 Sensory Adaptations of Aquatic Organisms</p> <p>Sensory Systems in Aquatic Environments</p> <p>Vision, Hearing, and Chemoreception in Aquatic Animals</p> <p>Electroreception and Mechanoreception in Aquatic Environments</p>
3.	Human Impacts on Aquatic Ecosystems	<p>3.1 Anthropogenic Threats to Aquatic Ecosystems</p> <p>Understanding Human Impact on Aquatic Environments</p> <p>Identifying Anthropogenic Stressors: Pollution, Overfishing, Habitat Destruction</p> <p>3.2 Pollution and its Effects on Aquatic Life</p> <p>Types of Aquatic Pollution: Chemical, Nutrient, and Plastic Pollution</p> <p>Impact of Pollution on Aquatic Organisms and Ecosystems</p> <p>3.3 Overfishing and Habitat Destruction</p> <p>Overfishing: Causes, Consequences, and Global Trends</p> <p>Habitat Destruction and Fragmentation: Loss of Biodiversity and Ecosystem Function</p> <p>Impacts on Fisheries and Marine Ecosystems</p> <p>3.4 Sustainable Management Practices for Aquatic Resources</p> <p>Principles of Sustainable Fisheries Management</p> <p>Ecosystem-based Management Approaches</p> <p>Integrating Conservation with Economic Development: The Role of Policy and Governance</p>

Prescribed Text/s (If any):

1. Goldman, C. (1994) Limnology (2nd edition).

2. Ananthkrishnan, T.N. (1989) Bioresources Ecology (3rd edition).
3. Odum, E.P. and Barrett, G.W. (2004) Fundamentals of Ecology (5th edition).
4. Pawlowski, L. (1980) Physicochemical Methods for water and Wastewater Treatment.
5. Wetzel, R. (2001) Limnology (3rd edition) Elsevier.
6. Trivedi, R.K. and Goyal, P.K. (1986) Chemical and biological methods for water pollution studies.
7. Welch, P.S. (2014) Limnology Vol. I-II.

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Introduction to Aquatic Ecosystems	Chalk and Talk, Powerpoint presentations, interactive discussions etc.	10
2.	Aquatic Organisms	Chalk and Talk, Powerpoint presentations, interactive discussions etc.	10
3.	Human Impacts on Aquatic Ecosystems	Chalk and Talk, Powerpoint presentations, interactive discussions etc.	10

Evaluation Pattern

C) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

D) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Introduction to Aquatic Ecosystems	Essay/Short notes (10 marks)	10
2.	2. Aquatic Organisms	Essay/Short notes (10 marks)	10
3.	3. Human Impacts on Aquatic Ecosystems	Essay/Short notes (10 marks)	10

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Aquatic Biology
Class	S. Y. B. Sc.
Semester	III
Course Code	USZOO306
No. of Credits	2
Nature	Practical
Type	Minor

	Practical USZOO305	2 Credits
1.	To determine the levels of dissolved oxygen in water samples.	
2.	To determine the levels of carbon dioxide in water samples.	
3.	To determine the levels of biochemical oxygen demand (BOD) in water samples.	
4.	To determine the levels of chemical oxygen demand (COD) in water samples.	
5.	To determine the levels of sulphate in the water samples.	
6.	To analyze water samples for the amount of total dissolved solids (TDS) and total suspended solids (TSS).	
7.	Estimation of Phosphorus and Silicates in water samples.	
8.	Identification of locally available Seaweeds.	
9.	Qualitative analysis of phytoplankton and zooplankton in the provided water sample.	
10.	Estimation of primary productivity by light and dark bottle method.	
11.	Identification and classification of aquatic insects.	
12.	To study the modifications in Hill stream fishes	
13.	To study the different types of swim bladder in fishes.	
14.	To study the adaptations/modifications in Deep sea and Cave dwelling fishes.	
15.	Study of morphometric measurements on fish specimens to quantify their physical characteristics and assess population variability.	
16.	Study of GIS (Geographic Information Systems) and remote sensing techniques to map aquatic habitats, including shoreline features, bathymetry, and habitat types.	
17.	Investigate microbial activity in aquatic environments by collecting water samples and incubating them with nutrient agar plates to observe bacterial growth.	
18.	Field visit to a nearby lake to observe and document the topography of a lake ecosystem, including its physical features, landforms, and surrounding landscape.	

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(viva voce, report submission, journal, active participation in lab work and attendance etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	-	Experiment 1	10
2.	-	Experiment 2	10
3.	-	Experiment 3	10

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Evolutionary Biology	
Class	S. Y. B. Sc.	
Semester	IV	
Course Code	USZOO405	
No. of Credits	2	
Nature	Theory	
Type	Minor	
Course Outcomes:		
CO1- Learners will acquire an in-depth understanding of the diversity and interrelationships within the animal kingdom.		
CO2- Learners will develop a holistic appreciation of the phylogenetic relationships and adaptations observed in animals.		
CO3- Students will be enabled to comprehend the evolution of the universe and the origins of life.		
CO4- Students will gain a comprehensive understanding of the processes and theories in evolutionary biology.		
CO5- Learners will develop a keen interest in the debates and discussions within the field of evolutionary biology.		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Origin of Life and evidences of Evolution	1.1 Evolution, science, and anti-science: the present threat to rationality. 1.2 Life's Beginnings: Chemogeny, RNA world, Biogeny, 1.3 Origin of Photosynthesis and Evolution of Eukaryotes: Evolution of photosynthesis and its role in shaping Earth's ecosystems. Understanding the transition from prokaryotic to eukaryotic life forms. 1.4 Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism. 1.5 Evidences of Evolution: The fossil record (types of fossils, transitional forms) Geological time scale, evolution of horse, Molecular universality of genetic code and protein Synthesizing machinery Three domains of life- Archaea, Bacteria, and Eukarya, Neutral theory of molecular evolution and molecular Clock, Example of a globin gene family, rRNA/cyt c;

		1.6 Sources of variations: Heritable variations and their role in evolution
2.	Evolutionary forces	<p>2.1 Hardy-Weinberg Law: Statement and derivation of the Hardy-Weinberg equation Application of the law to human populations</p> <p>2.2 Evolutionary forces upsetting H-W equilibrium: Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load,</p> <p>2.3 Types of selection: Density-dependent selection, heterozygous superiority, kin selection, and adaptive resemblances. Exploring sexual selection and its role in evolutionary processes.</p> <p>2.4 Genetic drift: Mechanisms, founder's effect, and bottleneck phenomena.</p> <p>2.4 Understanding the impact of migration and mutation on changing allele frequencies.</p>
3.	Origin and evolution of man and the interpretation method	<p>3.1 Microevolutionary Changes Exploring inter-population variations and clines. Understanding the concept of races and its implications. Investigating species concepts and isolating mechanisms.</p> <p>3.2 Modes of speciation: Allopatric and sympatric speciation.</p> <p>3.3 Adaptive Radiation and Macroevolution Case study: Evolutionary radiation exemplified by Galapagos finches. Insights into extinctions: Background and mass extinctions, causes, and effects. Detailed examination of the K-T extinction event and its significance.</p> <p>3.4 Origin and Evolution of Man Unique characteristics of hominins compared to primates. Tracing primate phylogeny from <i>Dryopithecus</i> to <i>Homo sapiens</i>. Molecular analysis of human origins and its implications.</p> <p>3.5 Interpretation Methods Understanding phylogenetic trees and their construction. Techniques such as multiple sequence alignment in evolutionary analysis. Interpreting phylogenetic trees to understand evolutionary relationships and patterns.</p>
<p>Prescribed Text/s (If any): 1. Ridley, M (2004) Evolution (3rd edition) Blackwell publishing 2. Hall, B.K. and Hallgrimson, B. (2008) Evolution (4th edition) Jones and Barlett Publishers</p>		

3. Campbell, N.A. and Reece J.B (2011) Biology (9th edition) Pearson, Benjamin, Cummings
4. Douglas, J.F. (1997) Evolutionary Biology. Sinauer Associates.
5. Pevsner, J. (2009) Bioinformatics and Functional Genomics (2nd edition) Wiley Blackwell.
6. Futuyama, D. J. (1986). Evolution, Systematics and Animal Behaviour. Evolutionary Biology. Sinauer Associates Inc.
7. Strickberger, M. W. (2007). Evolution. CBS Pub.
8. Colbert, E. H.; Morales, M. & Minkoff, E. I. (2001). Evolution of the Vertebrates, Science.
9. Moody, P. A. (2002). Introduction to Evolution, Kalyani Pub.

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Origin of Life and evidences of Evolution	Chalk and Talk, Powerpoint presentations, interactive discussion etc.	10
2.	Evolutionary forces	Chalk and Talk, Powerpoint presentations, interactive discussion etc.	10
3.	Origin and evolution of man	Chalk and Talk, Powerpoint presentations, interactive discussion etc.	10

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Origin of Life and evidences of Evolution	Essay/Short notes (10 marks)	10
2.	2. Evolutionary forces	Essay/Short notes (10 marks)	10
3.	3. Origin and evolution of man	Essay/Short notes (10 marks)	10

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Evolutionary Biology
Class	S. Y. B. Sc.
Semester	IV
Course Code	USZOO406
No. of Credits	2
Nature	Practical
Type	Minor

	Practical USZO	2 Credits
1.	Study of fossils from models/ pictures.	
2.	Study of homology and analogy from suitable specimens.	
3.	Study and verification of Hardy-Weinberg Law by chi-square analysis.	
4.	Demonstration of the role of natural selection and genetic drift in changing allele frequencies using simulation studies.	
5.	Study of allopatric, sympatric, and parapatric speciation	
6.	Types of eggs based on quantity and distribution of yolk: Sea urchin, insect, frog, Chick.	
7.	Study of adaptive radiations in feet of birds and mouth parts of insects.	
8.	Study of mammalian placenta- Histological and morphological types	
9.	Chick Embryology: Egg, Sperm, Primitive streak, 24H, 36H and 48 Hours embryo whole mount.	
10.	Comparative embryology of vertebrate and invertebrate embryos to identify conserved developmental stages and structures.	
11.	Exploring the Adaptations of two or more species through Mimicry.	
12.	Comparison of two birds belonging to the same species but different subspecies (Intraspecific difference).	
13.	Study of metabolic adaptations in organisms with diverse ecological niches, such as deep-sea fish or desert-dwelling mammals.	
14.	Evolution of man- Ramapithecus, Australopithecus, Neanderthal man and Cromagnon man	
15.	To construct a cladogram based on morphological or molecular data to represent evolutionary relationships among taxa	
16.	Study of Evolutionary Relationships within several closely related species within a taxonomic group with the help of DNA sequencing technique.	
17.	Study of construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and their interpretation.	
18.	Graphical representation and interpretation of data of height/ weight of a sample. (100 humans in relation to their age and sex)	

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(viva voce, report submission, journal, active participation in lab work and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	-	Experiment 1	10
2.	-	Experiment 2	10
3.	-	Experiment 3	10

Date:

Place: Ratnagiri



Signature
Chairperson and HoD



R.E. Society's
**R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND
R.V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS),
RATNAGIRI**

NAAC accredited 'A' Grade (4th Cycle)
Ratnagiri-415612 (Maharashtra-India)

**S.Y. B. Sc. SYLLABUS FOR
ZOOLOGY**

Skill Enhancement Course (SEC)

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2024-2025

PREAMBLE:

In alignment with our commitment to providing a holistic and experiential education, we are delighted to introduce two Skill Enhancement Courses (SECs) – Haematological Techniques and Beekeeping – as integral components of the Zoology curriculum for Second-Year B.Sc. students, commencing from the academic year 2024-2025. These SECs are designed to augment students' theoretical knowledge with practical skills and hands-on experience in specialized areas of biological sciences, thereby enriching their academic journey and preparing them for diverse career pathways.

Haematological Techniques:

The Haematological Techniques course offers students an immersive exploration into the fascinating field of haematology, the study of blood and its disorders. From the ancient origins of haematology to the modern practices of blood analysis, students will delve into the historical development and evolving methodologies of this critical discipline. Through engaging lectures, laboratory sessions, and practical demonstrations, students will gain a comprehensive understanding of blood composition, functions, and the diagnostic techniques employed in haematological analysis.

Furthermore, this course equips students with essential laboratory skills for blood cell counting, morphology analysis, and hemostasis assays. By learning to interpret haematological data and diagnose common blood disorders, students will develop the proficiency required for clinical laboratory settings, research institutions, and healthcare facilities.

Beekeeping:

The Beekeeping course invites students into the captivating world of apiculture, offering an immersive journey into the art and science of beekeeping. With a rich historical backdrop spanning ancient civilizations to modern practices, students will explore the evolution of beekeeping techniques and the pivotal role of bees in human societies. From taxonomy and morphology to colony management and honey harvesting, students will acquire practical skills and theoretical knowledge essential for successful beekeeping ventures.

Through interactive lectures, field trips, and hands-on demonstrations, students will learn the fundamentals of bee biology, hive management, disease identification, and pest control. Moreover, they will gain insights into the critical role of bees in pollination services and ecosystem health, fostering an appreciation for sustainable beekeeping practices and conservation efforts. By the end of the course, students will be equipped with the skills and confidence to embark on their beekeeping endeavours, contributing to both environmental sustainability and economic empowerment.

These SECs reflect our dedication to offering a well-rounded education, equipping students with practical skills and a thirst for lifelong learning. Let's embark on this journey with curiosity and innovation, shaping future professionals and stewards of nature.

**Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.**

OBJECTIVES:

Haematological Techniques (Semester III):

1. Equip students with fundamental knowledge of haematology, including blood composition, functions, and disorders.
2. Familiarize students with laboratory techniques for blood cell counting, morphology analysis, and hemostasis assays.
3. Enhance students' ability to interpret haematological data and diagnose common blood disorders.
4. Provide practical training in bone marrow examination and analysis.
5. Prepare students for careers in clinical laboratories, research institutions, and healthcare settings where haematological skills are required.

Beekeeping (Semester IV):

1. Introduce students to the history, systematics, and morphology of bees, emphasizing honey bee species.
2. Develop practical skills in colony management, including hive inspection, disease identification, and pest control.
3. Train students in honey harvesting, processing, and packaging techniques.
4. Provide insights into the importance of bees in pollination services and conservation efforts.
5. Equip students with the knowledge and skills necessary for starting and managing their beekeeping operations.
6. Foster an appreciation for sustainable beekeeping practices and their role in environmental conservation.

STRUCTURE OF THE COURSE:

SEMESTER – III

ZOOLOGY- SKILL ENHANCEMENT COURSE (USZOOSEC307)

COURSE CODE	COURSE TITLE	Title	CREDITS	NO. OF LECTURES
USZOOSEC307	Haematological Techniques	Practicals	2	60

SEMESTER – IV

ZOOLOGY- SKILL ENHANCEMENT COURSE (USZOOSEC407)

COURSE CODE	COURSE TITLE	Title	CREDITS	NO. OF LECTURES
USZOOSEC407	Beekeeping	Practicals	2	60

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Haematological techniques	
Class	S. Y. B. Sc.	
Semester	III	
Course Code	USZOOSEC307	
No. of Credits	2	
Nature	Practical	
Type	SEC	
Course Outcomes:		
CO1- Learners will understand haematology principles, encompassing blood physiology, functions, and disorders.		
CO2- Learners will analyze various haematological parameters, including blood cell counts, morphology, and coagulation profiles.		
CO3- Learners will understand the pathobiology of haematological disorders encountered in hospital practice, including anaemia, leukaemia, and hemostatic disorders.		
CO4- Learners will interpret diagnostic test results accurately, including peripheral blood smears, bone marrow examinations, and coagulation assays.		
CO5- Learners will identify erroneous test results and develop strategies to troubleshoot and rectify them, ensuring accuracy in haematological diagnostics.		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
	Haematological techniques	Hematology Overview: Introduction to the study of blood, its historical development, and its importance in medicine and research. Blood Composition and Functions: Overview of blood components (plasma, formed elements) and their functions. Hematopoiesis: Formation and regulation of blood cells. Common Blood Disorders: Types, causes, symptoms, and treatment of anaemia, leukaemia, and hemostatic disorders. Diagnostic Techniques: Blood cell count and morphology, hemostasis assays, and bone marrow examination.
Prescribed Text/s (If any):		
1. Textbook of Medical Laboratory Technology P.B Gotkar Mumbai, Bhalani Publishing House		
2. Textbook of Medical Laboratory Technology by Paraful B. Godkar, Publisher Bhalani		
3. Textbook of Medical Laboratory Technology (2nd edition) by V.H Talib, Publisher CBS		
4. Atlas of Hematology (5th edition) by G.A. McDonald, Publisher Churchill Livingstone		
5. Medical Laboratory Technology By K.L Mukharjee, Publisher McGraw Hill Education PVT limited		
6. Textbook of Medical Laboratory Technology (6th edition) by Ramnik Sood, Jaypee Publication.		

Other Learning Resources recommended:

PRACTICALS (USZO307)		1 Credit
1.	Proper use and care of common laboratory instruments- Microscope, centrifuge, weighing balance, deep freezer, water bath etc.	
2.	Study of various methods of collection and storage of blood samples – Veinpuncture, fingerprick methods, types of anticoagulants, containers etc.	
3.	Separation of plasma, serum and their storage	
4.	Blood Typing and Cross-Matching for Transfusion Compatibility.	
5.	Preparation of Blood Smear for Microscopic Examination	
6.	Clotting and Bleeding Time Measurement	
7.	Estimation of Hemoglobin (Hb) using Sahli's Acid Hematin Method	
8.	Determining the Red Blood Cell Count (RBC Count)	
9.	Determining the White blood cell count (WBC Count)	
10.	Differential Leucocyte Count in Human Peripheral Blood by Leishman Staining	
11.	Determination of Erythrocyte sedimentation rate (ESR)	
12.	Preparation of haemin crystals	
13.	Estimation of blood glucose by glucose oxidase - peroxidase method	
14.	Estimation of cholesterol level in Human serum by Zak method.	
15.	Estimation of serum transaminases (AST, ALT) and serum alkaline phosphatase (ALP)	
16.	Blood Group Antigen Detection Using Agglutination Tests.	
16.	Electrophoretic separation of plasma proteins.	
17.	Interpretation of Blood pathological reports.	
18.	Visit to a Pathological Laboratory and Report Analysis	

Evaluation Pattern

E) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

F) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.		Essay/Short notes (10 marks)	10
2.		Essay/Short notes (10 marks)	10
3.		Essay/Short notes (10 marks)	10

Evaluation Pattern

C) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(viva voce, report submission, Journal, active participation in lab work and attendance, etc.)	20

D) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	-	Experiment 1	10
2.	-	Experiment 2	10
3.	-	Experiment 3	10

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Beekeeping	
Class	S. Y. B. Sc.	
Semester	IV	
Course Code	USZOOSEC407	
No. of Credits	2	
Nature	Practical	
Type	SEC	
Course Outcomes:		
<p>CO1 - Understand the historical development, scope, and significance of apiculture.</p> <p>CO2 - Recognize the crucial role of bee flora in sustaining bee populations and honey production.</p> <p>CO3 - Understand the principles of hive construction and its implications for bee management.</p> <p>CO4 - Understand the importance of sustainable beekeeping practices in ensuring long-term viability.</p> <p>CO5 -Familiarize themselves with advanced techniques like migratory beekeeping and commercial pollination services.</p> <p>CO6 - Students will apply Knowledge in Beekeeping Operations:</p> <p>CO7 - Translate theoretical knowledge into practical applications in real-world beekeeping scenarios.</p> <p>CO8 -Demonstrate proficiency in implementing hive management practices to optimize bee health and productivity.</p> <p>CO9- Develop problem-solving skills to address challenges encountered in beekeeping operations effectively.</p> <p>Curriculum:</p>		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
	Introduction to Apiculture	<p>History of Beekeeping: Evolution from ancient to modern practices.</p> <p>Systematics of Bees: Classification and diversity.</p> <p>Bee Morphology: Anatomy and adaptations.</p> <p>Colony Organization: Social structure.</p> <p>Bee Flora: Importance for honey production.</p> <p>Purchasing and Site Selection: Acquiring healthy colonies and ideal locations.</p> <p>Colony Management: Inspection and health monitoring.</p> <p>Harvesting Products: Honey extraction and processing.</p> <p>Disease Management: Identifying and preventing diseases.</p> <p>Queen Rearing: Techniques for colony expansion.</p> <p>Pollination Services: Importance and conservation.</p> <p>Specialized Practices: Sustainable methods and breeding.</p>

Prescribed Text/s (If any):

1. Abrol, D. P. (1997) Bees and Beekeeping. Kalyani Publisher, New Delhi. 172
2. Abrol, D. P. (2010) A Comprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.
3. Withhead, S. B. (2010) Honey bees and their management Axis books Publisher, Jodhpur.
4. Nagaraja, N. and Rajagopal, D. (2013) Honey bees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.
5. Dharamsing and Singh, D. P. A Handbook of Beekeeping, Agrobios India (Publisher), Jodhpur.

Other Learning Resources recommended:

	PRACTICALS (USZO407)	1 Credit
1.	Study of morphology and anatomy of honey bees (different body parts of honey bees and their modifications)	
2.	To differentiate between various species and sub-species of honey bees based on morphological characteristics.	
3.	To observe and document the stages of development in the life cycle of honey bees.	
4.	To observe the social structure and organization within a honey bee colony and understand the division of labour among colony members.	
5.	To observe the developmental stages and life cycle of different castes of honey bees.	
6.	Study of Queen Rearing Techniques: Grafting and Cell Builder Setup.	
7.	To become acquainted with different tools and equipment used in modern beekeeping for domesticating hive bees.	
8.	Performing routine maintenance and repairs on beekeeping equipment, including hive boxes, frames, and protective gear.	
9.	To recognize common pests and predators of honey bees and implement control measures.	
10.	To identify symptoms of common honey bee diseases and develop management strategies.	
11.	Honey Harvesting and Processing: Extracting, Filtering, and Bottling.	
12.	To assess the quality of honey through various tests including purity, moisture content, and other physical and chemical parameters.	
13.	Organizing educational workshops or demonstrations for community members or school groups to learn about beekeeping practices and the importance of pollinators.	
14.	A field visit to an apiculture unit for the study of beekeeping practices and hive management techniques.	

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(viva voce, report submission, journal, active participation in lab work and attendance, etc.)	20

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	-	Experiment 1	10
2.	-	Experiment 2	10
3.	-	Experiment 3	10

Date:

Place: Ratnagiri



Signature
Chairperson and HoD



R.E. Society's
**R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND
R.V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS),
RATNAGIRI**

NAAC accredited 'A' Grade (4th Cycle)
Ratnagiri-415612 (Maharashtra-India)

**S. Y. B. Sc. SYLLABUS
FOR
OPEN ELECTIVE COURSES (OE)**

Global Environmental Issues

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2024-2025

PREAMBLE

In line with the forward-looking principles outlined in the National Education Policy (NEP) of 2020, we are excited to introduce an Open Elective Course on Global Environmental Issues for second-year B.Sc. Students. This course represents a significant stride towards realizing the transformative goals of NEP 2020, which prioritize practical skills, comprehensive education, and an engaging, student-centred approach.

NEP 2020 imagines an educational framework that not only imparts theoretical knowledge but also equips students with the practical skills necessary for success in their chosen paths. Our Open Elective Course is crafted to bridge the gap between classroom learning and real-world challenges, aligning seamlessly with NEP 2020's focus on hands-on learning and skill development.

Through this course, students will explore a range of environmental issues affecting our planet today, from climate change to pollution and beyond. They will not only learn about these problems but also develop a deeper understanding of their causes, consequences, and potential solutions.

By emphasizing practical application and critical thinking, we aim to empower students to become informed global citizens capable of addressing environmental challenges in their personal and professional lives. Our commitment to aligning with NEP 2020's vision for practical skill development and holistic education is at the core of this initiative.

**Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.**

OBJECTIVES:

1. Provide a hands-on exploration of global environmental issues.
2. Foster understanding of the causes and effects of environmental challenges.
3. Develop critical thinking skills for analyzing environmental problems.
4. Encourage active participation and engagement with real-world environmental issues.
5. Equip students with knowledge and skills to contribute to solutions for environmental problems.
6. Cultivate awareness of the interconnectedness of environmental, social, and economic systems.
7. Promote a sense of responsibility and stewardship towards the environment.
8. Align with the principles of NEP 2020 by emphasizing practical skill development and holistic education.

STRUCTURE OF THE COURSE

SEMESTER III

ZOOLOGY- OPEN ELECTIVE COURSE (USZOOOE308)

OPEN ELECTIVE COURSE CODE	COURSE TITLE	Unit	Title	CREDITS	NO. OF LECTURES
USZOOOE308	Global Environmental Issues	1	Understanding Global Environmental Issues	2	30
		2	Environmental Economics		
		3	Use of Microbes in Waste Water Treatment		

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Global Environmental Issues	
Class	S. Y. B. Sc.	
Semester	III	
Course Code	USZOOOE308	
No. of Credits	2	
Nature	Theory	
Type	OE	
Course Outcomes:		
CO1- Learners will understand the fundamental concepts and challenges of the environment, including issues related to sustainability and environmental degradation.		
CO2- Learners will analyze different sources of environmental problems and methods for measuring pollution, enhancing their ability to assess and address environmental issues effectively.		
CO3- Learners will examine the relationship between economic growth and the quality of life, exploring how economic development impacts environmental sustainability and human well-being.		
CO4- Learners will comprehend the microbiology of wastewater treatment, including aerobic and anaerobic decomposition processes, and their role in mitigating environmental pollution.		
CO5- Learners will assess various wastewater treatment schemes, gaining insights into their efficiency and applicability in treating sewage from different industrial sources.		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Understanding Global Environmental Issues	1.1 Introduction to Global Environmental Problems Overview of Major Environmental Challenges Impact of Anthropogenic Activities on the Environment Importance of Addressing Global Environmental Issues 1.2 Ozone Depletion: Causes, Effects, and Solutions Understanding Ozone Depletion and its Causes Consequences of Ozone Depletion for Human Health and the Environment Strategies for Mitigating Ozone Depletion 1.3 UV-B Radiation and its Impacts on Ecosystems Effects of Enhanced UV-B Radiation on Biological Systems Impact of UV-B Radiation on Plants, Animals, and Microbes Management Strategies to Reduce UV-B Exposure 1.4 Greenhouse Effect and Climate Change

		<p>Concept of the Greenhouse Effect and its Role in Climate Change</p> <p>Consequences of Climate Change for Global Ecosystems</p> <p>Adaptation and Mitigation Strategies to Address Climate Change</p> <p>1.5 Acid Rain: Causes, Effects, and Remediation</p> <p>Sources and Formation of Acid Rain</p> <p>Ecological and Environmental Effects of Acid Rain</p> <p>Approaches for Minimizing Acid Rain and its Impacts</p>
2.	Environmental Economics	<p>2.1 Basic Concepts of Environmental Economics</p> <p>Definition and Scope of Environmental Economics</p> <p>Interactions between Economy and Environment</p> <p>Importance of Environmental Considerations in Economic Decision-Making</p> <p>2.2 Methods of Economic Evaluation in Environmental Economics</p> <p>Techniques for Valuing Environmental Goods and Services</p> <p>Economic Models for Environmental Assessment</p> <p>Cost-Benefit Analysis and its Application in Environmental Decision-Making</p> <p>2.3 Economic Growth and its Impacts on the Environment</p> <p>Relationship between Economic Growth and Environmental Degradation</p> <p>Ecological Footprint of Economic Development</p> <p>Strategies for Sustainable Economic Growth</p> <p>2.4 Economics of Pollution: Causes and Effects</p> <p>Economic Analysis of Pollution Sources and Impacts</p> <p>Externalities and Market Failures in Pollution Generation</p> <p>Costs of Environmental Degradation to Society</p>
3.	Use of Microbes in Waste Water Treatment	<p>3.1 Aerobic Decomposition Processes</p> <p>Overview of Common Aerobic Treatment Methods</p> <p>Examination of activated sludge process and oxidation ponds</p> <p>Understanding trickling filters and tower systems</p> <p>Application of rotating discs, drums, and oxidation Ditches</p> <p>3.2 Anaerobic Decomposition Processes</p> <p>Introduction to anaerobic wastewater treatment</p> <p>Analysis of anaerobic filters and up-flow reactors</p> <p>Comparison of anaerobic and aerobic treatment methods</p> <p>3.3 Treatment Schemes for Various Industries</p> <p>Challenges and solutions in dairy wastewater treatment</p> <p>Methods and considerations for distillery effluent treatment</p> <p>Approaches to tannery, sugar, and pharmaceutical waste water treatment</p>

		3.4 Microbial Consortia in Waste Water Treatment Role of microbial communities in biodegradation Diversity and dynamics of microbial populations Bioremediation Strategies and System Optimization Microbial degradation of organic pollutants and heavy Metals Challenges and prospects in microbial wastewater treatment
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Prescribed Text/s (If any):

1. Frances, H. (2012). Global Environmental Issues (2nd edition) Willey-Blackwell
2. Mahesh, R. (2007) Environmental Issues in India: A Reader. Pearson-Longman.
3. Environmental Science: Earth as a Living Planet by Daniel B. Botkin and Edward A. Keller
4. Environmental Science: Toward a Sustainable Future by Richard T. Wright and Dorothy F. Boorse
5. Living in the Environment: Principles, Connections, and Solutions by G. Tyler Miller Jr. and Scott Spoolman
6. Global Environmental Politics: From Person to Planet by Simon Nicholson and Paul Wapner
7. Introduction to Environmental Engineering and Science by Gilbert M. Masters and Wendell P. Ela
8. Our Global Environment: A Health Perspective by Anne Nadakavukaren

Other Learning Resources recommended:

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
1.	Understanding Global Environmental Issues	Chalk and Talk, Powerpoint presentations, interactive discussions etc.	10
2.	Environmental Economics	Chalk and Talk, Powerpoint presentations, interactive discussions etc.	10
3.	Use of Microbes in Waste Water Treatment	Chalk and Talk, Powerpoint presentations, interactive discussions etc.	10

Evaluation Pattern

G) Continuous Internal Evaluation: Maximum Marks:20

Method	Marks
(Class test, home assignment, seminar, viva voce, report submission, active class participation and attendance, etc.)	20

H) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions (If any) (E.g. Q. 1 a) ...	Unit and sub-unit (with number and title)	Type of Question (Essay / short note / Objective / Diagram, etc.)	Marks
1.	1. Understanding Global Environmental Issues	Essay/Short notes (10 marks)	10
2.	2. Environmental Economics	Essay/Short notes (10 marks)	10
3.	3. Use of Microbes in Waste Water Treatment	Essay/Short notes (10 marks)	10

Date:

Place: Ratnagiri



**Signature
Chairperson and HoD**



R.E. Society's
**R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND
R.V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS),
RATNAGIRI**

NAAC accredited 'A' Grade (4th Cycle)
Ratnagiri-415612 (Maharashtra-India)

**S. Y. B. Sc. SYLLABUS
FOR
OPEN ELECTIVE COURSES (OE)**

Neurobiology and Behaviour

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2024-2025

PREAMBLE:

We are delighted to introduce the Open Elective Course on Neurobiology and Behavior for Second-Year B.Sc. Students, commencing from the academic year 2024-2025. This course represents a significant stride towards fostering a deeper understanding of the intricate workings of the human brain and its influence on behaviour. As we delve into the captivating realm of neurobiology, we embark on a journey to unravel the mysteries of the mind and explore the fascinating complexities of behaviour.

The study of neurobiology and behaviour holds immense significance in the fields of biology, psychology, medicine, and beyond. By delving into the mechanisms underlying brain function and behaviour, we gain invaluable insights into fundamental aspects of human nature, cognition, and emotion. Moreover, understanding the neural basis of behaviour has far-reaching implications, ranging from advancing treatments for neurological disorders to elucidating the mechanisms of learning and memory.

Through this course, we aim to cultivate a profound appreciation for the interdisciplinary nature of neuroscience and its relevance to diverse academic and professional pursuits. By integrating theoretical knowledge with practical applications, we strive to empower students to critically analyze and explore the complexities of neural systems and behavioural patterns.

As we embark on this educational journey, let us embrace curiosity, inquiry, and a spirit of discovery. Together, we will unravel the mysteries of the brain and gain a deeper understanding of the fascinating interplay between neurobiology and behaviour.

**Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.**

OBJECTIVES :

1. Explore the fundamental principles of neurobiology, including neuronal structure and function.
2. Investigate the neural mechanisms underlying various behaviours, such as learning, memory, and emotion.
3. Examine the interplay between genetics, environment, and neural circuits in shaping behaviour.
4. Discuss the latest research findings and advancements in the field of neurobiology.
5. Foster critical thinking skills in evaluating experimental evidence and scientific literature.
6. Analyze case studies and real-world examples to illustrate the application of neurobiology to behaviour.
7. Encourage collaborative learning and peer discussion through group projects and presentations.
8. Provide a foundation for further study and research in neuroscience-related disciplines.

STRUCTURE OF THE COURSE

SEMESTER IV

ZOOLOGY-OPEN ELECTIVE COURSE (USZOOOE408)

OPEN ELECTIVE COURSE CODE	COURSE TITLE	Unit	Title	CREDITS	NO. OF LECTURES
USZOOOE408	Neurobiology and behaviour	1.	Foundations of Neurobiology and Behavior	2	30
		2.	Behavioral Neuroscience		
		3.	Cognitive Neuroscience and Higher Brain Functions		

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2024-25

Nomenclature of the Course	Neurobiology and behaviour	
Class	S. Y. B. Sc.	
Semester	IV	
Course Code	USZOOOE408	
No. of Credits	2	
Nature	Theory	
Type	OE	
Course Outcomes:		
CO1- Understand the fundamental principles of neurobiology and neuronal communication.		
CO2- Analyze the mechanisms underlying behaviour, including sensory processing and motor control.		
CO3 - Explore the neural basis of memory, decision-making, and social interaction.		
CO4 - Familiarize with neuroscientific research methods such as neuroimaging and electrophysiology.		
CO5 - Appreciate the interdisciplinary nature of neuroscience and its applications in various fields.		
Curriculum:		
Syllabus:		
Unit No.	Unit Title	Subtitles (Learning Points)
1.	Foundations of Neurobiology and Behaviour	1.1 Introduction to Neurobiology Basic concepts in neurobiology Structure and function of the nervous system Neurons and neural communication 1.2 Neurotransmission and Synaptic Communication Mechanisms of neurotransmitter release and action Synaptic transmission: Excitatory and inhibitory neurotransmission Neurotransmitter receptors and their roles in signal transduction 1.3 Neural Circuits and Brain Regions Organization of neural circuits Major brain regions and their functions Neural pathways underlying basic behaviors 1.4 Neuroplasticity and Learning Mechanisms of neural plasticity Synaptic plasticity and long-term potentiation Neural basis of learning and memory 1.5 Methods in Neurobiology Research

		<p>Neuroimaging techniques: MRI, fMRI, PET</p> <p>Electrophysiological methods: EEG, patch-clamp recording</p> <p>Molecular and cellular techniques: Western blotting, immunohistochemistry</p>
2.	Behavioural Neuroscience	<p>2.1 Introduction to Behavioural Neuroscience</p> <p>Basic principles of behavioural neuroscience</p> <p>Relationship between brain and behavior</p> <p>2.2 Sensory Systems and Perception</p> <p>Neural processing of sensory information</p> <p>Perception of visual, auditory, olfactory, and tactile stimuli</p> <p>Disorders of sensory perception</p> <p>2.3 Motor Control and Movement</p> <p>Neural circuits controlling movement</p> <p>Motor coordination and voluntary movement</p> <p>Disorders of motor control: Parkinson's disease, Huntington's disease</p> <p>2.4 Emotion and Motivation</p> <p>Neural basis of emotions</p> <p>Regulation of motivation and reward pathways</p> <p>Disorders of emotion and motivation: Depression, addiction</p> <p>2.5 Sleep and Circadian Rhythms</p> <p>Neural mechanisms underlying sleep and wakefulness</p> <p>Regulation of circadian rhythms</p> <p>Sleep disorders and their impact on health</p>
3.	Cognitive Neuroscience and Higher Brain Functions	<p>3.1 Memory and Cognition</p> <p>Neural basis of memory formation and retrieval</p> <p>Cognitive processes: Attention, perception, language</p> <p>Disorders of memory and cognition: Alzheimer's disease, amnesia</p> <p>3.2 Consciousness and Awareness</p> <p>Theories of consciousness</p> <p>Neural correlates of consciousness</p> <p>Altered states of consciousness: Meditation, anaesthesia</p> <p>3.3 Decision Making and Executive Functions</p> <p>Neural mechanisms of decision making</p> <p>Executive functions: Planning, reasoning, problem-solving</p> <p>Disorders of executive function: ADHD, schizophrenia</p> <p>3.4 Social Neuroscience</p> <p>Neural basis of social behavior and interaction</p> <p>Empathy, theory of mind, and social cognition</p> <p>Disorders of social behaviour: Autism spectrum disorders, sociopathy</p>
<p>Prescribed Text/s (If any):</p> <p>1. Principles of Neural Science by Eric R. Kandel, James H. Schwartz, and Thomas M. Jessell</p> <p>2. Neuroscience: Exploring the Brain by Mark F. Bear, Barry W. Connors, and Michael A.</p>		

Paradiso 3. Essential Neuroscience by Allan Siegel and Hreday N. Sapru 4. Fundamental Neuroscience edited by Larry Squire, Darwin Berg, Floyd E. Bloom, Sascha du Lac, and Anirvan Ghosh 5. Neurobiology: A Functional Approach by Georg F. Striedter Other Learning Resources recommended:
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Teaching Plan:			
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3.	3. Cognitive Neuroscience and Higher Brain Functions	Essay/Short notes (10 marks)	10

Date:

Place: Ratnagiri



**Signature
Chairperson and HoD**