

APPENDIX-I

Academic Year 2026-27 Detailed Programme Structure & Syllabus

Structure of M.Sc. Zoology

Year	Sem.	Course Code	Paper Title	Theory/Practical	Max. Marks.	Credits
1	I	PGZY-101	Diseases Biology and Parasitology	Theory	100	4
		PGZY-102	Physiology and Biochemistry	Theory	100	4
		PGZY-103	Animal Behavior and Wild Life Biology	Theory	100	4
		PGBR-01	Basics in Research	Theory	100	4
		PGZY-105 (P)	Practical based on 101N, 102N and 103N	Practical Work	100	4
1	II	PGZY-106	Chordata	Theory	100	4
		PGZY-107	Developmental Biology	Theory	100	4
		PGZY-108	Genetics and Evolution	Theory	100	4
		PGED-02	Entrepreneurship Development	Theory	100	4
		PGZY -110 (P)	Practical based on 106N,107N and 108N	Practical Work	100	4
2	III	PGZY-111	Molecular Cell Biology	Theory	100	4
		PGZY-112	Environmental Biology	Theory	100	4
		PGZY-113	Tools and Techniques	Theory	100	4
		PGRT-03	Basic Research Tools	Theory	100	4
		PGZY-115 (P)	Practical based on 111N,112N and 113N	Practical Work	100	4
2	IV	Compulsory Papers				
		PGZY-118	Bioinformatics	Theory	100	4
		PGZY-123 N (D)	Dissertation and Viva-voce	Viva-voce	100	4
		Choose any one group (Group I OR Group II)				
		Group I				
		PGZY-116	Fisheries	Theory	100	4
		PGZY-117	Entomology	Theory	100	4
		PGZY-119 (P)	Practical's based on PGZY 116 N ,117 N and 118 N	Practical Work	100	4
		OR				
		Group II				
		PGZY-120 (D)	Cytogenetics	Theory	100	4
		PGZY-121	Genetic Engineering	Theory	100	4
		PGZY-122 (P)	Practical based on 118 N, 120 N and 121N	Practical Work	100	4

Syllabus for M.Sc. (Zoology)

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: I	Semester : I
Subject: Zoology		
Course Code: PGZY-101	Course Title: Diseases Biology and Parasitology	
Course Objectives: The main objectives of the course is to develop basic knowledge and skill to identify the parasites and disease caused by them. , prevent and control parasitic diseases.		
Course Outcomes: (CO): - at the end of the course the students will be able to identify the parasites at different stages of life cycle, there vectors and host by macroscopic or microscopic examination as appropriate. - describe the parasitic zoonotic diseases and host parasites relationship in nematodes and also describe the micro and macro environment of parasites.		
Credits: 04		Type of Course: Core
Max. Marks: 100	Min. Passing Marks: 36	
Block 1	Pathogen and Transmission of Parasite	
Unit I	Introduction to Parasitology Brief Introduction of parasitism, parasite, parasitoid and vectors Host parasite relationship, Mode of transmission of parasite, Host specificity and parasitic adaptation.	
Unit II	Parasitic Protozoa -I Basic principles and concept of parasite protozoa. Classification, Morphology, life cycle, epidemiology, pathogenicity, diagonosis, prophylaxis, and treatment of <i>Leishmania</i> , <i>Giardia lamblia</i> and <i>Trypanosoma species</i>	
Unit III	Parasitic Protozoa –II Malaria parasites of human- distribution and habitats, Classification, Morphology, life cycle, epidemiology, pathogenicity, diagnosis, prophylaxis, and treatment of malaria Parasite <i>Plasmodium</i> sp.	
Unit IV	Parasitic Platyhelminthes-I Classification General account, primary and secondary host of cestodes, egg hatching variation of life cycle with examples.	
Unit V	Parasitic Platyhelminthes-II Classification General account, primary and secondary host of trematodes, egg hatching variation of life cycle in Monogenea and Digenea with examples.	
Unit VI	Parasitic Nematoda - I Parasitic Nematoda, Classification Morphology, life cycle, epidemiology, pathogenicity, diagnosis, prophylaxis of Ascariasis, Hookworm, Filariasis, <i>Dracunculus medinensis</i> , <i>Wucheriria bancrofti</i>	
Unit VII	Parasitic Nematoda - II Classification Morphology, life cycle, epidemiology, pathogenicity, diagnosis, prophylaxis of <i>Fasciolopsis buski</i>, <i>schistosoma haematobium</i>, Ancylostoma, Host-parasite relationship.	
Unit VIII	Host parasites relationship in nematode Concept of Plant diseases, Host parasites relationship in nematode infection. Effect of abiotic factors in nematode multiplication. Mechanism involved in injury histopathology of infected tissue.	
Block-2	Pathogen and Transmission of Parasite -II	
Unit IX	Parasitic Arthropods Biology, importance and control of ticks: Soft tick (<i>Ornithodoros</i>), Hard tick (<i>Ixodes</i>), Mites (<i>Sarcoptes</i>), Lice (Pediculus), Flea (<i>Xenopsylla</i>) and Bug (<i>Cimex</i>).	

Unit X	Parasite Vertebrates Cookicutter Shark, Hood Mocking bird, Vampire bats and their parasitic behavior and effect on host.
Unit XI	Micro and Macro environment of parasites Micro and Macro environment of parasites, Autecology and synecology of parasitic helminthes.
Unit XII	Host parasite interactions Physiology of host parasite interactions, immunological control of vector borne and non vector borne diseases. Population dynamics of helminthes, Bio-invasion and helminthes.
Suggested Text Book Readings: 1. Cheng, T.C. General parasitology Academic Press, Inc. (1986) 2. Noble, E.R. and Noble, G.A: Parasitology, The biology of Animal parasites Lea and Fabiger 3. Andeson, D.R.: Comparative Protozoology, Cambridge Uni. Press. 4. Chandler, A.C. and Read, C.P.; Introduction of Parasitology, Willy Eastern, 5. Belding, D.A. A text book of Prasitology, Meredith pub. Co. 6. Baker, J.R. Parasitic Protozoa, Academic Press 7. Grell, K.G. Protozoology, Springer Verlag	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: I	Semester: I
Subject: Zoology		
Course Code: PGZY-102	Course Title: Physiology and Biochemistry	
Course Objectives: The main objectives of this course is the structure and functioning of various organs and there interrelationship and to give adequate information to the students regarding such as structure and biological importance of carbohydrates, proteins, lipids, enzymes and vitamins.		
Course Outcomes:(CO): At the end of the course the students will be able to: • an integrated understanding of physiological mechanisms. • described the physiology of digestive and respiratory system of human beings. • understood the blood composition, types, groups and circulatory system. • described the physiology of excretory system and nervous system of human beings. • came to know the physiology of sense organs, muscles and reproductive system. • explained the structure and biological importance carbohydrates, proteins and lipids. • explained the specificity of enzymes (biochemical catalysts), and the chemistry involved in enzyme action. • understood types, structure, biochemical properties and functions of vitamins. • explained how the metabolism of organic compounds leads ultimately to the generation of large quantities of atp. • described the structure and classification of hormones.		
Credits: 04		Type of Course: Core (√) /Elective
Max. Marks: 100	Min. Passing Marks: 36	
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Physiology-I	
Unit I	Digestion Chemical digestion, digestion and absorption of food (proteins, Carbohydrates, lipids) Gastrointestinal system- Neural control gastrointestinal function- bile secretion and cholesterol, homeostasis, immune function of GI tract, physiology of gastrointestinal disorders.	
Unit II	Muscles and Nerve Fibre Types of muscles- Physiological anatomy of skeletal muscle, Smooth muscle- structure, types of functions, mechanism of smooth muscle contraction, Cardiac muscle- structure and function.	
Unit III	Nervous System Structure and function of nervous system, Neuron structure, Resting membrane potential, action potential, strength duration curve. Nerve fibre- Classification, conduction of impulses in myelinated and Non-myelinated nerve fibres. Degeneration and regeneration of nerve fibre. Synapse, transmission, properties, synaptic, inhibition, Neurotransmitters.	
Unit IV	Respiration Respiratory pigments, oxygen and carbon-dioxide transport, mechanism and regulation of respiration.	
Unit V	Excretion Kidney structure study of tubular function, tubular transport mechanism and trans tubular potential, role of kidney in regulation of ionic, osmotic, acid and base balance of the body fluid, control of extracellular fluid volume nitrogen excretory products, urine formation.	
Unit VI	Osmoregulation Osmoregulation in fresh water and marine fishes. Osmoregulation in migratory fishes. Homeostasis- neural and hormonal	
Block 2	Physiology II and Biochemistry I	
Unit VII	Circulation and Endocrine System	

	Circulation- types of circulation, physiological categories of heart. Menstrual cycle, Regulation of ovarian and testicular functions, Endocrine regulation of implantations, Lactation and its hormonal regulation, placenta in mammals. Neuroendocrine system and neuro-secretions.
Unit VIII	Biochemistry of carbohydrates, proteins and lipids. Structure and biological importance of carbohydrates, proteins and lipids Metabolism of carbohydrates- glycolysis and citric acid cycle, gluconeogenesis, pentose phosphate pathway
Unit IX	Biosynthesis of amino acids (Phenylalanine, Tryptophan, Aspartate, Proline, Threonine) deamination and transamination of amino acids.
Unit X	Lipids- Biosynthesis of Palmitic acid, Ketogenesis Fatty acid synthesis and triglyceride storage in adipocytes promoted by insulin and triglyceride hydrolysis and fatty acid.
Block 2	Biochemistry II
Unit XI	Enzymes Kinetics of enzyme reaction- Kinetics of enzyme- catalyzed, order of enzyme reaction, rate, two substrate reactions; Temperature Coefficient, Activation energy, Enzyme inhibition- Competitive and non competitive inhibitors; Application of enzyme inhibition techniques in pest control, allosteric enzyme
Unit XII	Vitamins Fat and water soluble vitamins, vitamins as coenzymes. Structure and functions of vitamins and coenzymes.
Suggested Text Book Readings: - Ruegg, J.C., Calcium in muscle activation, Springer Verlag Berlin Heidelberg, New York. 25 - Hoar, W.S. General and comparative physiology, Prentice, Hall Inc./England Wood cliffs, New Jersey. - Guyton, A.C. and Hall, J.E.; Text book of medical physiology, 10th Ed, Saunders, Harcourt, India. - Heilmeyer, L.M.G. Cellular regulation of protein phosphorylation, springer-verlag, Berlin Heidelberg, New York. - Prosser, C.L. and Brown, F.A. comparative Animal Physiology 2 nd Ed. W.B. Saunders, Philadelphia. - Karpati, G., Jones, D.H. and Griggs. R.C. Disorders of Voluntary Muscle, 7th Edn, Cambridge University Press. - Turner, C.D. General Endocrinology, 4th Ed. W.B. Saunders, Philadelphia London. - Prosser, C.L., Comparative Animal Physiology, W.B. Saunders, Toppen Publication. - Zubay, G. 1988, biochemistry (2nd ed), Macmillan Publ. House N.Y. - Mahler, H.R. and codes F.H. 1971. Biological chemistry, Harper International. - Lehinger. A.L. 1978, Biochemistry Kalyani Publishers, Ludhiana - Goodwin T.W. and Meriar L.E.I. 1989 Introductory plant Biochemistry pergamon Press VY. - Conn, E.E. and Shimpap, P.K. 1976. Outlines of Biochemistry Wiley Eastern - Styer, Biochemistry. - Freifelder Molecular Biochemistry.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: I	Semester: I
Subject: Zoology		
Course Code: PGZY-103	Course Title: Animal Behavior and Wild Life Biology	
Course Objectives: The main objectives of animals behavior, impart knowledge about animal responses to external stimuli and explain through examples development , evolution and occurrence of the behaviour.		
Course Outcomes:(CO): At the end of the course the students will be able to: • describe the neurological basis of behavior • also describe in the social and sexual behavior. • describe in the biological rhythms. • describe in the wild life biology.		
Credits: 04		Type of Course: Core (√) /Elective
Max. Marks: 100		Min. Passing Marks: 36
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Animal Behaviour- I	
Unit I	Selection of Habitat Factors affecting survival, behavior, choice of breeding sites Habitat selection, determinants of habitat preference.	
Unit II	Evolutionary and neurological basis of behavior Evolutionary and neurological basis of behavior, Innate behavior, Stereotyped and acquired behavior, Neural and hormonal control of behavior. Patterns of communication (chemical, visual, light, audio, Species specificity of songs, evolution of language with respect to primates)	
Unit III	Social Behavior Flocking in birds, herding in mammals Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness Social organization in insects and primates. Social structure and behavior Parental care with reference to fish, amphibians and birds. Territorial behavior	
Block 2	Animal Behaviour- II	
Unit IV	Sexual behavior Sexual behavior: Courtship, sexual selection, mating patterns, Monogamy, polygamy, polyandry Sexual conflict, parental investment, Infanticide. Female choice, male quality and courtship,	
Unit V	Biological rhythms Circadian and circannual rhythms Orientation and navigation Masking and entrainment Phase shift, Phase response curves (PRC) and phase transition curves (PTC) Biological rhythms and human health Sleep, Neural mechanisms of sleep	
Unit VI	Pheromones and behavior Pheromones and Hormones Hormones and behavior Role of pheromones	
Unit VII	Anatomy and physiology of the time Photoperiodic time measurement Types and properties of biological rhythms Geophysical environment Seasons; proximate and ultimate factors Regulation of Seasonal Migration	

Block 3	Wild Life Biology
Unit VIII	Introductory wild life Biology Brief history of wild life in India Biodiversity, level of biodiversity Importance of wild life, vanishing wild life.
Unit IX	Protected Indian wild life Indian threatened mammals Indian threatened birds Indian threatened reptiles IUCN red list of animals
Unit X	Important Indian Wild life Endangered species and their distributions Project Tiger and its evaluation Other animal projects and their updates
Unit XI	National Parks, Sanctuaries, and Biosphere reserves Important National parks Important National Sanctuaries Important National Biosphere reserves Zoological gardens and museums
Unit XII	Methods of Wild life conservation Habitat managements, reintroduction in wild Mass education and awareness Promulgation of laws Wild life organizations, Red data book Problems of wildlife managements in India Wildlife Health and Population management.
Suggested Text Book Readings: 1. Barnes et al (2009), The Invertebrates: A synthesis, Wiley Backwell 17 2. Hunter; Life of Invertebrates (1979, Collier Macmillan) 3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7 th ed 1972, Macmillan) 4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press) 5. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill 6. Thomos C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd., Asia, New Delhi. 7. Bisht. D.S. <i>Apiculture</i> , ICAR Publication.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: None		
Programme: M.Sc./M.A.	Year: I	Semester: I
Subject: Statistics		
Course Code: <i>PGBR-01</i>	Course Title: <i>Basics in Research</i>	
Course Objectives: The main objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods, survey, Plagiarism and copyright issue.		
Course Outcomes: CO1: To write a good qualitative research statement and design the research questions. CO2: To know about the hypothesis, conduct the survey and a qualitative case study. CO3: Able to know the Plagrism and copyright issue for writing research paper and project.		
Credits: 4	Type of Course: Core	
Max. Marks: 100	Min. Passing Marks: 36	
BLOCK 1	Basic of Research	
Unit 1	Introduction to Research: Knowledge and the Approaches of Acquiring knowledge (deductive, inductive and scientific), Meaning of Research, Objectives of Research, Motivation in Research, Significance of Research, Importance of knowing How Research is Done?, Criteria of Good Research	
Unit 2	APPROACHES OF RESEARCH: Types of Research, Research Approaches, Research Methods versus Methodology, Research and Scientific Method, Research Process	
Unit 3	DEFINING THE RESEARCH PROBLEM: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique involved in Defining a Research Problem.	
Unit 4	RESEARCH DESIGN: Need for Research Design, Features of Good Design, Important Concepts Relating to Research Design, Different Research Design, Basic Principles of Experimental Designs.	
BLOCK 2	LITERATURE SURVEY, REVIEW, AND SYNOPSIS PREPARATION	
Unit 5	Literature Survey: Introductions: Sources of information, need for reviewing literature, primary-secondary and tertiary sources, journals, abstracts, text books, Web resources, E-journals, journal access, case study alerts. Citation index, UGC infonet, E-books, Impact Factors, Search engines- Google scholar, Science Direct, SciFinder, Scopus, web of science.	
Unit 6	Literature Review: Establishing the Context, Identifying Gaps in Knowledge, Formulating Research Questions or Hypotheses, Defining Key Concepts and Terms, Selecting Research Methods, Supporting Research Design and Methodology, Evaluating Research Methods, Citing Relevant Studies, Avoiding Redundancy, Synthesizing Knowledge, Demonstrating Scholarly Engagement, Guiding the Organization of Your Research Paper, Providing a Theoretical Framework, Supporting Ethical Research, Contributing to the Research Conversation, Types of Review of literature.	
Unit 7	Preparation of Research Synopsis: The structure of synopsis- Title, Introduction, Literature	

	Review, Research Questions or Hypotheses, Methodology, Data Collection, Data Analysis, Expected Outcomes and Significance, Timeline, References, Budget, Appendices.
BLOCK 3	ETHICS AND IPR
Unit 8	Research Ethics: Regulatory bodies, practices and compliances, Good Laboratory Practices (GLP), Research Ethics & Misconduct.
Unit 9	Intellectual Property Rights: Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties. Plagiarism, Patents, Fundamentals of patents, Product and process patent, Patent Treaties and Convention, process of filing patent (Search and retrieval), copyrights, geographical indications, design and layout, trademarks.
Unit 10	Ethical consideration for research: Informed Consent, Privacy and Confidentiality, Minimizing Harm and Risks, Beneficence, Justice and Fairness, Deception, Publication Ethics, Peer Review, Conflict of Interest, Animal Welfare, Data Management and Sharing, Community and Stakeholder Involvement, International Research Ethics.
BLOCK 4	RESEARCH REFERENCE, REPORT AND PAPER WRITING
Unit11	Reference Writing: APA Style (American Psychological Association), MLA Style (Modern Language Association), Chicago Style, IEEE Style (Institute of Electrical and Electronics Engineers), AMA Style (American Medical Association), Harvard Style, Vancouver Style, Turabian Style, CSE Style (Council of Science Editors), Bluebook Style. Tips for writing references.
Unit12	Report writing in academics and research: Various kinds' of academic and research activities. Necessity of report writing for achievement of academic and research goals. Various kinds of reports / presentations. Characteristics of academic and research reports / presentations. Conclusions. Scientific Writing – Introduction to Technical writing, definition, types, characteristics, Report Writing, Research proposal writing.
Unit13	Research paper writing: Choose a Topic, Conduct a Literature Review, Formulate a Research Question or Hypothesis, Plan Your Research, Gather Data, Organize Your Research, Write an Outline, Write the Introduction, Literature Review, Methodology, Results, Discussion, Conclusion, Cite Your Sources, Proofread and Edit, Formatting and References, Finding a Suitable Journal, Submit Your Paper, Peer Review and Revision, Final Proofreading.
Block 5	RESEARCH TOOLS AND STATISTICAL METHODS
Unit 14	Basics of Data, Research Tools, and Types of Variables- Research Tools for Data Collection- Questionnaire , Structured vs. Semi-structured, Open-ended and closed-ended questions, Interview Schedule -Face-to-face, telephonic, or digital, Observation Method , Participant and non-participant observation- Checklist and Rating Scale , Likert scales, semantic differential scales, Dietary Assessment Tools , 24-hour recall, food frequency questionnaire (FFQ), food diary, Anthropometric Measurement Tools , Weighing scale, stadiometer, measuring tape,

	MUAC, BMI chart. Types of Data and Variables -Qualitative vs. Quantitative, Nominal, Ordinal, Interval, Ratio, Dependent and Independent Variables. Understanding Data Distributions -Normal and skewed distributions, checking normality: Histogram, Q-Q Plot, Shapiro-Wilk test.
Unit 15	Parametric Statistical Tools and Applications - Descriptive Statistics (Parametric), Mean, Median, Mode, Standard Deviation, Variance, Percentiles and Z-scores, Inferential Parametric Tests, t-tests , One-sample t-test, Independent samples t-test, Paired samples t-test, One-way ANOVA , F-test, post-hoc interpretation, Correlation and Regression , Pearson correlation, Simple Linear Regression (assumptions, interpretation, R^2), Confidence Intervals and p-values , Interpretation and significance, Tools Used : MS Excel, SPSS, Examples : Comparing mean hemoglobin between groups, Predicting BMI from daily calorie intake.
Unit 16	Non-Parametric Statistics and Risk Estimation Tools -Descriptive Statistics (Non-Parametric), Median, Mode, Interquartile Range, Non-Parametric Tests , Chi-square Test, Test of independence using contingency tables, Mann-Whitney U Test , Comparison of two independent groups, Wilcoxon Signed-Rank Test , Paired samples, Kruskal-Wallis Test , Non-parametric ANOVA alternative, Risk Estimation Tools , Odds Ratio (OR), Use in case-control studies, Interpretation, Relative Risk (RR) , Use in cohort studies, 2x2 tables, Manual and SPSS calculation, Tools Used : SPSS, Manual calculation using examples, Examples : Association between junk food and obesity, Risk of anemia based on dietary habits.
Suggested Text Book Readings: 1. C.R. Kothari, Gaurav Garg. Research Methodology: Methods and Techniques, New Age International Publishers, 2019. 2. Kumar, R: Research Methodology: A Step-by-Step Guide for Beginners, (3rd Edition), SAGE, Inc., 2011. 3. https://onlinecourses.swayam2.ac.in/cec22_ge28/preview	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: I	Semester: II
Subject: Zoology		
Course Code: PGZY-106	Course Title: Choradata	
Course Objectives: The paper deals with the comparative and evolutionary trends in structure and function of the organ system of the vertebrates.		
Course Outcomes:(CO): At the end of the course the students will be able to: • getting introductory glimpse of vertebrates and essential connection between various chordates. • understand the various system evolved in different groups of organisms. • students will enrich their knowledge by comparing evolutionary research in vertebrates. • students will get to know about higher kingdom of vertebrates along with their related anatomy and physiology.		
Credits: 04	Type of Course: Core (√) /Elective	

Max. Marks: 100		Min. Passing Marks: 36
Block 1	Origin and Classification of Chordates	
Unit I	Primitive chordates Origin of chordates: Introduction and charterers of chordates. Classification of chordates up to order level. Hemichordates: General characters and classification up to order level. Study of <i>Balanoglossus</i> and its affinities.	
Unit II	Urochordata and Cephalochordata General characters and classification up to order level study of <i>Herdmania</i> and its affinities. Cephalochordates: General characters and classification up to order level. Study of <i>Branchiostoma</i> (Amphioxus) and its affinities.	
Unit III	Origin, evolution and adaptive radiations of vertebrates. Origin evolution and general characters of Agnatha (Petromyzon). Fishes: General Characters and classification up to order level. Types of Scales and fines of fishes, Scoliodon as type study. Migration and parental care in fishes.	
Unit IV	A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi. Adaptive radiation in bony fishes	
Block 2	Amphibians, Reptiles and Birds	
Unit V	Amphibians: General characters and classification up to order level, <i>Rana tigrina</i> as type study, parental care, neoteny.	
Unit VI	Reptilia: General characters and classification up to order level. Uromastix as type study. Identification of poisonous and non-poisonous snakes and biting mechanism of snakes. Extinct reptiles, Dinosaurs- Types and evolutionary significance.	
Unit VII	Origin and evolution of birds: General characters and classification up to order level. Study of Columba (Pigeon) and Characters of Archaeopteryx. Flight adaptations & bird migration.	
Block 3	Origin and evolution of Mammals	
Unit VIII	Origin of mammals. General characters and classification up to order level, affinities of Prototheria, Metatheria and Eutheria. Economic importance of mammals.	
Unit IX	Evolution of man. Relationships of man with other primates, fossil record of ancestry of man.	
Unit X	Comparative anatomy of vertebrates. Comparative anatomy of digestive system, respiratory system.	
Unit XI	Comparative anatomy of Skeletal system, Circulatory system.	
Unit XII	Comparative anatomy of Excretory system, Reproductive system.	
Suggested Text Book Readings: 1. Campbell: Biology (Benjamin) 2. Marshall and Williams: Text Book of Zoology 3. Wolfe: Biology the Foundations (Wadsworth) 4. Parker & Haswell: Text Book of Zoology Vol.II (Macmillan) 5. Prescott: Cell (Jones & Bartlett). 6. M.Kato. The Biology of Biodiversity, Springer. 7. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York. 8. Modern textbook of Zoology Vertibrates by R.L. Kotpal		
This course can be opted as an elective by the students of following subjects: NA		
Suggested equivalent online courses (MOOCs) for credit transfer: NA		

Course prerequisites: To study this course, a student must have qualified graduation with Biology		
Programme: M.Sc.	Year: I	Semester: II
Subject: Zoology		
Course Code: PGZY-107	Course Title: Development Biology	
Course Objectives: The main objective of developmental biology course is to provide four dimensional thinking of students to truly understand the patterns and process of embryonic development, body plan, fate map, recreative biology.		
Course Outcomes:(CO): At the end of the course the students will be able to: • based on learning contents of embryology, students can have a systematic and organized learning about the knowledge and concepts of growth and development. • developmental biology displays a rich array of material and conceptual practices that can be analysed to better understand the scientific reasoning exhibited in experimental life sciences. • developing new ideas and innovation to understand the basis of life.		
Credits: 04	Type of Course: Core (√) /Elective	

Max. Marks: 100		Min. Passing Marks: 36
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Development Biology-I	
Unit I	Introduction: developmental biology • Scope, science of developmental biology and its applications. • Developmental pattern in metazoan.	
Unit II	Principles of developmental Biology • Introduction of Developmental Biology: The Stages of animal development, Embryonic homologies, malformations and teratology. • Developmental patterns in Unicellular Protists and Metazoa. • The developmental mechanics of cell specification. • Determining the function of genes during development.	
Unit III	Early Embryonic Development • Introduction to embryonic development: Structure of Gametes, recognition of egg and sperm, acrosomal reaction. • The early development of snails. • The genetics of <i>Drosophila</i> development: Anterior, and posterior axis formation in <i>Drosophila</i>, Dorsal-ventral and left-right axes in <i>Drosophila</i>.	
Unit IV	Later Embryonic development • Tetrapod limb development • Sex determination approaches in developmental biology. • Metamorphosis, regeneration and ageing' • The development of blood cells: the stem cell concept, the pluripotential hematopoietic stem cells, blood and lymphocyte lineages, hematopoiesis	
Block 2	Development Biology-II	
Unit V	Germ cell • Migration in amphibians, birds and mammals, differentiation of germ cells into sperm or egg.	
Unit VI	Spermatogenesis • Detailed study of the process of mammals, gene expression during sperm development.	
Unit VII	Oogenesis Oogenic meiosis, roll of progesterone in oogenesis, Vitellogenesis,	
Unit VIII	Fertilization Fertilization (pre and post-fertilization events, biochemistry of fertilization), nature of eggs and their cleavage; gastrulating; organogenesis of vertebrate brain, eye and heart.	
Block 3	Development Biology-III	
Unit IX	Induction and Organizer Concept Determination of polarity and symmetry; pattern regulation in insect imaginal discs; induction and organizer concept; differentiation at the level of chromosomes.	
Unit X	Regenerative Biology Regeneration and gradients in developing system, ageing and cellular death; transgenic animals and knock outs, Unique properties of stem cells-embryonic stem cells-adult stem cells-umbilical cord stem cells-similarities and differences between embryonic and adult stem cells. Properties of stem cells pluripotency- totipotency	
Unit XI	Metamorphosis and organogenesis in model organisms <i>Drosophila</i> : Axes, compartment and pattern formation, HOX gene and their regulation. <i>Caenorhabditis elegans</i> : Early development and vulva formation. <i>Xenopus</i> : Organizer formation, mesoderm specification <i>Zebrafish</i> : Cell movement and signal during early development, Patterning polarity and regionalization of nervous system. Limb development in vertebrate.	
Unit XII	Environment and Development	

	Evolution of viviparity in mammals; cellular and biochemical events in metamorphosis of insects and amphibians, causes of fetal deformities. Environment control of gene regulation, Epigenetic regulation of developmentally relevant genes.
Suggested Text Book Readings: 1. Developmental biology by Dr. M.A. Subramanian 2. Development biology by Scott. F. Gilbert. 3. A text book of embryology (Developmental Zoology) by N. Arumugam 4. Fundamental concepts of developmental biology by Das. N.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: I	Semester: II
Subject: Zoology		
Course Code: PGZY-108	Course Title: Genetics and Evolution	
Course Objectives: The objective course is to explore the human heredity and how our understanding of them is revealed by scientific experiments and also explain the how the molecular record provides evidence for evolution.		
Course Outcomes:(CO): At the end of the course the students will be able to: • fundamental molecular principles of genetics • the structure and function of DNA & RNA • described the basics of genetic mapping. • described the DNA replication gene transcription, translation of mRNA and gene regulation. • by biological evolution we could understand that many of the organisms that inhabit the earth today are different from those that inhabited it in the past . • understood that the four propositions underlying darwin's theory of evolution through natural selection are more individuals are produced than can survive; there is therefore, a		

struggle for existence, individuals within a species show variation, offspring tend to inherit their parental characters. - explained adaptation, providing examples from several different fields of biology. - explained how the molecular record provides evidence for evolution - understood the human origin and evolution.	
Credits: 04	Type of Course: Core (√) /Elective
Max. Marks: 100	Min. Passing Marks: 36
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)	
Block 1	Genetics
Unit I	Patterns of inheritance Mendelian inheritance Features of Chromosomes, Sex chromosomes Chromosome theory of inheritance, Extension of Mendelian inheritance Gene interactions, Maternal effect, Extranuclear inheritance, linkage
Unit II	Genetic transfer and Mapping in Bacteria Bacterial transformation, selection and mapping Bacterial conjugation, and mapping via Hfr strains Bacterial transduction
Unit III	Variation in Chromosome structure and number Eukaryotic chromosome Deletions and duplications Inversions and translocations Changes in chromosome number, Aneuploidy
Unit IV	Molecular structure of nucleic acids Nucleotide structure Discovery and structure of DNA double helix RNA structure and types
Unit V	DNA replication Prokaryotic DNA replication Eukaryotic DNA replication Regulation of DNA replication
Unit VI	Gene transcription and RNA modification Transcription in prokaryotes Transcription in eukaryotes RNA modification Structure and function of tRNA,
Unit VII	Translation of mRNA Genetic basis of protein synthesis Genetic code and amino acids Ribosome structure and assembly Stages of translation
Block 2	Evolution
Unit VIII	Origin of life Early concepts and theories Modern concept of origin of life, Miller's experiments Evidences in favour of organic evolution
Unit IX	Lamarckism and Darwinism Lamarck's theory, Analysis of Lamarck's theory Criticism of Lamarckism, Neo-Lamarckism Darwin's theory- natural selection and origin of new species Criticism and objections of Darwinism, Neo-Darwinism
Unit X	Mutation theory Mutation, molecular basis of mutation

	Types of mutation, Causes of mutation Mutagenic agents, Significance of mutation
Unit XI	Isolation, adaptation and variation Isolating mechanisms, reproductive isolation Genetic basis of isolation, role of isolation in evolution Different kinds of adaptation Kinds of variations, sources of variation, significance of variation.
Unit XII	Evolution of Human Ancestral apes, fossil human Origin of modern human, races of modern human Distribution of human diversity and colonization
Suggested Text Book Readings:	
1. Lodish, et. al., 2013, Molecular Cell Biology, 7th Edition, W.H. Freeman Publisher. 2. Russell, P.J, 2006, Genetics (5th Ed.), Addison Wesley Longman, California, USA. 3. Snustad, P., and Simmons, M.J, 2011, Principles of Genetics. (6th Ed.), John Wiley, New York. 4. Robertis, EDP De & Robertis, EMF De, 2002, Cell and Molecular Biology (8th Edition), Lippincott Williams & Wilkins International Student Edition, Philadelphia. 5. Chawla, H.S., Introduction to Plant Biotechnology (2nd edition), Oxford and IBH Publishing, Co. Pvt. Ltd., New Delhi. 6. Glick, B.R. and Pasternak, J.J., 1998, Molecular Biotechnology: Principles and Applications, ASM Press, Washington DC. 7. Kanai S. Molecular evolution of the photolyase-blue-light photoreceptor family. 8. Origin of Species by Charles Darwin 9. Origin and evolution by John and Marry Gribbian	

Course prerequisites: None		
Programme: M.Sc./M.A.		Year: I
Subject: Mathematics		
Course Code: PGED-02		Course Title: Entrepreneurship Development
Credits: 4		Type of Course: Core
Max. Marks: 100		Min. Passing Marks: 36
Unit 1	Entrepreneurship Introduction, Meaning, Evolution & Concept Of Entrepreneurship, Nature Of Entrepreneurship, Importance Of Entrepreneurship, Elements Of Entrepreneurship Characteristics Of Entrepreneurship, Need Of Entrepreneurship, Functions Of Entrepreneurship Types Of Entrepreneurship, Merits Of Entrepreneurship, Demerits Of Entrepreneurship, Entrepreneurship And Environment The Need Of Entrepreneurship For Indian Economy ,Introduction, Views Of Leading Thinkers, Drucker's Views On Entrepreneur Walker's Views On Entrepreneur.	
Unit 2	Entrepreneur Meaning, Concept, Characteristics Of An Entrepreneur Qualities Of	

	Entrepreneur, Difference Between Entrepreneurship And Entrepreneur, Difference Between Entrepreneur, Intrapreneur And Manager, Difference Between Entrepreneurship And Intrapreneurship
Unit 3	Functions And Types Of Entrepreneur Introduction, Basic Functions Of An Entrepreneur, Process To Setup An Enterprise, Difference Between Managerial Functions And Entrepreneurial Functions Of An Entrepreneur, Types Of Entrepreneurs,
Unit 4	Theories Of Entrepreneurship Introduction, Economic Theories, Neoclassical Economic Theories Of Entrepreneurship , Sociological Theories Of Entrepreneurship, Psychological Theories Of Entrepreneurship, Cultural Theories Of Entrepreneurship
Unit 5	Entrepreneurship Development Programme: Introduction, Evolution And Concept Of Entrepreneurship Development Programme , Meaning, Features Of Entrepreneurship Development Programme , Need Of Entrepreneurship Development Programme , Objectives Of Entrepreneurship Development Programme , Formulation Of Entrepreneurship Development Programme , Outline Of Entrepreneurship Development Programme , Achievements Of Entrepreneurship Development Programme
Unit 6	Entrepreneurship Development In India: Meaning, Sustainable Entrepreneurship Development, Phases Of Entrepreneurship Development In India, Emergence Of Entrepreneurial Class In India, Locational Mobility Of Entrepreneurs, The Key Factors Influencing The Mobility Of Entrepreneurs , Entrepreneurial Performance In India, Entrepreneurship Development Cycle, Institutions For Entrepreneurship Development
Unit 7	Women Entrepreneurship: Introduction, Meaning, Characteristics Of Women Entrepreneurship, Factors Affecting The Need For Women Entrepreneurship, Problems Of Women Entrepreneurs, Remedies/ Overcoming/Solutions To The Problems Of Women Entrepreneurs, Steps To Promote Women Entrepreneurs, Traits Of Successful Women, Benefits Of Women Entrepreneurship
Unit 8	Promotion Of Ventures: Meaning And Concept Of Projects, Characteristics Of Project, Types Of Projects, The Boundaries Of A Project, Project Life Cycle – Stages, Success Of A Project, Implementation Of A Project, Benefits Of Project Management, Project Management, .Task Management, Difference Between Task Management And Project Management , Uses Of Project Management And Task Management, Project Identification, Identification Stage Diagram, Formulation And Report, Project Appraisal, Product Selection And Technique, Criteria And Factors To Be Considered In New Product Selection Stages, Phases Involved In New Product Selection Exercise
Unit 9	Project Management: Introduction, Meaning And Concept Of A Project, Characteristics Of A Project, Importance Of Project Management, Tools And Techniques Of Project Management, Classification Of Project, Project Life Cycle And Its Phases, The Project Manager, Roles And Responsibilities Of Project Manager
Unit 10	Raising Funds: Introduction, Concept & Relevance Of Finance For The Entrepreneur, Choices Between Sources Of Financial Capital, Sources Of Funds, The Advantages And Disadvantages Of The Different Sources Of Finance, Steps In Managing Finance, Objectives Of Financial Planning For The Entrepreneur
Unit 11	Legal Requirements For Establishment Of New Business Unit: Introduction, Formalizing A Business Structure And Founders Agreement, . Applying For Business Licenses, Understanding Taxation And Accounting Laws. Adhering To Labour Law. Ensuring Protection Of Intellectual Property. Ensuring Effective Contract Management. Details About Winding Down The Business

Unit12	Financial Institution's Aid To Entrepreneurs Introduction, Assistance Of Financial Institutions To Entrepreneurs, Comprehensive Promotion Structure Of MSME Sector, Financial Institutions Supporting And Assisting Small Scale Industries (SSI) In India
Unit13	Network Analysis Meaning And Concept Of Network Analysis, Importance Of Network Analysis/Network Technique, Classification Of Network Techniques, Programme Evaluation And Review Technique (PERT), Procedure Followed In PERT ,Advantages Of Pert ,Limitations Of Pert ,Critical Path Method (CPM): ,Identification Of The Critical Path, Advantages Of Critical Path Method ,Limitations Of CPM ,Similarities Between Pert And CPM, Comparison Between Pert And CPM ,Differences Between PERT And CPM Financial Support System: Forms of Financial support, Long term and Short term financial support, Sources of Financial support, Development Financial Institutions, Investment Institutions
Unit14	Marketing Assistance To Entrepreneurs Introduction, Meaning, Types Of Markets Available To An Entrepreneur, Traditional Marketing, Entrepreneurial Marketing, Differences Between Traditional And Entrepreneurial Marketing
Unit15	Entrepreneurship Development: Intellectual Property Rights And MSME Introduction, IPR And MSME's, Patents ,The Patent Process, Types Of Patents, Who Can File For A Patent?, Trademarks, Types Of Trademarks, Registration Of Trademark, Copyrights ,Objectives Of Copyrights, Geographical Indications ,Industrial Designs ,Trade Secrets ,Integrated Circuits, Protection Of New Plant Variety, Need Of IPR For MSME
Unit16	Small Business Introduction, Meaning Of Small Business, Types Of Small Business, Nature Of Small Business, Characteristics Of Small Business Enterprises, Objectives Of Small Business, Importance Of Small Business, Process Of Establishing Small Business,
Unit 17	Project Budgeting/Capital Budgeting Introduction, Meaning And Definition Of Project/Capital Budgeting, Features Of Capital Budgeting, Importance And Need Of Capital Budgeting, Types Of Capital Expenditure, Factors Affecting Capital Investment Decisions
Unit 18	Project Control Introduction, Control Process, Scope Of Project Control, Techniques Of Schedule Control ,Techniques Of Cost Control
Unit 19	Entrepreneurial Consultancy Meaning, Entrepreneurial Consultancy: Process And Methods, Motives Or Reasons For Using Advisory Services, Approaches To Modern Ounselling, Marketing Counselling
Unit 20	E Commerce And Entrepreneurship Introduction, Meaning And Concept Of E-Commerce , Approaches Of E-Commerce , Relevance Of E-Commerce , Advantages Of E-Commerce, Disadvantages Of E-Commerce, Difference Between Traditional Commerce And E-Commerce
Unit 21	Planning Of Capital Structure Introduction, Meaning Of Capital Structure, Types Of Capital Structure, Importance Of Capital Structure, Factors Determining Capital Structure, Capital Gearing, Planning Of Capital Structure, Optimal Capital Structure, Determinants Of Capital Structure
Suggested Text Book Readings:	

1. **C.R. Kothari, Gaurav Garg. Research Methodology: Methods and Techniques, New Age International Publishers, 2019.**
2. Kumar, R: Research Methodology: A Step-by-Step Guide for Beginners, (3rd Edition), SAGE, Inc., 2011.
3. https://onlinecourses.swayam2.ac.in/cec22_ge28/preview

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: III
Subject: Zoology		
Course Code: PGZY-111	Course Title: Molecular Cell Biology	
Course Objectives: The main objectives of the course is learn the practiced aspects of cell biology. It will give the cell signalling mechanism, transport across cell membrane, cell cycle, cell death, cancer and cell biology of infection.		
Course Outcomes:(CO): At the end of the course the students will be able to: • This course will make students able to understand how the different cell physically and chemically works as unit of life.		

- Through this course, students will be able to appreciate the importance of various cell function and structure. - The study will help in the students to understand the new discoveries about the structure and internal functioning of the cell due to technological improvements. - The students will know about the basic cellular and molecular approaches for cancer development and drug treatment.	
Credits: 04	Type of Course: Core (√) /Elective
Max. Marks: 100	Min. Passing Marks: 36
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)	
Block 1	Biomembrane and Transport
Unit I	Biomembrane Transport across cell membrane, diffusion, active transport & pumps, Passive transport, Facilitated diffusion, Uniport, Symport and antiport., Membrane Potential, Co-transport by symporters or antiporters, Transport across epithelia.
Unit II	Cytoskeleton Microfilaments & microtubulus structure & dynamics. Microtubulus & mitosis process Cell movement intracellular transport, role of kinesin & dynein proteins Intermediate filaments and its significance
Unit III	Cell-Cell signalling Cell surface receptors Second messenger system MAP kinase pathways Signalling from plasma-membrane to nucleus
Unit IV	Cell-Cell adhesion & communication Ca ⁺⁺ dependent homophilic cell-cell adhesion Ca ⁺⁺ independent homophilic cell-cell adhesion Gap junction & connexions
Unit V	Cell matrix adhesion Integrins Collagen Non collagen component Cellulose fibril synthesis and orientation
Unit VI	Cell Cycle Mitosis and cell cycle Cyclines & cyclin dependent kinases Regulation of CDK-cycline activity
Block 2	Cellular Function and Cancer
Unit VII	Intracellular membrane Traffic Types of coated vesicles, Clathrin- coated vesicle Ultra structure of Golgi-complex SNARE-mediated membrane fusion Transport of vesicles from ER to Golgi-complex Transport of vesicles from Golgi-complex to organelles and plasma membrane
Unit VIII	Mitochondria: Energy House Ultra structure of mitochondria Role in cellular metabolism ATP synthase- structure and functioning, ATP production, Proton pump
Unit IX	Cell death/ Apoptosis Apoptosis definition, and significance Role of Caspases Cell surface death receptors and apoptosis

	Mechanisms of apoptosis Significance of apoptosis
Unit X	Cancer Cancer Vs tumor, features of cancer cells Cancer as a macroevolutionary process Sugar metabolism and cancer, Role of growth factors Biology of cancer- mechanisms Proto-oncogene and oncogenes, Tumor suppressor genes Cancer prevention and treatments- present and future.
Unit XI	Stem cells and Tissue renewal Stem cells- origin and features Formation of stem cell niche- molecular mechanism Tissue renewal- mechanisms Transformation of a stem cell Hierarchical stem cell system- Blood cell formation Regeneration and repair.
Unit XII	Cell Biology of infection Pathogens and infection- extracellular and intracellular Infection by viruses, bacteria and protozoans Role of cell surface receptors in infection Infection and cellular metabolism.
Suggested Text Book Readings: 1. Alberts, B., and Johnson, A., 2016, Molecular Biology of Cell, Garland Science Publisher. 2. Lodish, et. al., 2013, Molecular Cell Biology, 7th Edition, W.H. Freeman Publisher. 3. Russell, P.J, 2006, Genetics (5th Ed.), Addison Wesley Longman, California, USA. 4. Snustad, P., and Simmons, M.J, 2011, Principles of Genetics. (6th Ed.), John Wiley, New York. 5. Robertis, EDP De & Robertis, EMF De, 2002, Cell and Molecular Biology (8th Edition), Lippincott Williams & Wilkins International Student Edition, Philadelphia. 6. Glick, B.R. and Pasternak, J.J., 1998, Molecular Biotechnology: Principles and Applications, ASM Press, Washington DC. 7. Gupta, P.K. 1996, Elements of Biotechnology, Rastogi & Co., Pub., New Pub., Meerut, India.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: III
Subject: Zoology		
Course Code: PGZY-112	Course Title: Environmental Biology	
Course Objectives: The main objectives course is an introduction to the biology of environmental problems. This course is design to engage you with a broad perspective on our relationship with land, water, air and other living things and non-living things.		
Course Outcomes:(CO): At the end of the course the students will be able to: • Provides students with an in-depth knowledge of Cellular interaction with environment, abiotic and biotic components. • Also describe in the aquatic ecosystem and different types of pollution.		

- Explain the how human health is related to environmental health. - Summarize changes in economics, policy and education that promote sustainability.	
Credits: 04	Type of Course: Core (✓) /Elective
Max. Marks: 100	Min. Passing Marks: 36
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)	
Block 1	Environmental Biology-I
Unit I	Cellular interaction with environment System analysis including models in environmental Biology. Impact of environment at cellular level: Cellular interaction with environment.
Unit II	Environmental Physiology Environmental Physiology: Basic Metabolic rate and body size, Metabolism and climatic adaptations - Hibernation and aestivation Poikilotherms and Homeotherms Asphyxic responses. Response to temperature and Pressure. Haematological changes, Thermal properties of water and survival limits. Acclimatization.
Unit III	Abiotic and Biotic Components A detailed study of different ecosystems. (Study with include abiotic and biotic components and their interrelationship, productivity and adaptations of animals). Terrestrial Ecosystems : Grasslands (including grazing lands) Forests : Characteristics of alpins, temperate and tropical forests. Stratification, high altitude (with special reference to Himalayanecology) Deserts : Types and ecological attributes of desert biota. Taiga : Extent and ecological peculiarities Tundra : Extent and ecological peculiarities
Unit IV	Aquatic Ecosystem Aquatic Ecosystems : Fresh Water : Lakes (including salt lakes) Ponds streams, springs, rivers and marshes. Marine : Zonation fauna Esturine : Ecological peculiarities and adaptations (including impact on fauna) A general knowledge of Biogeography
Block 2	Environmental Biology-II
Unit V	Renewable and non-renewable energy resources Renewable and non-renewable energy resources, growing energy need, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, composition. Physico-chemical characteristics and energy content of coal, petroleum and natural gas.
Unit VI	Development and Evolution of Ecosystems Development and evolution of ecosystems: causes and kinds of succession diversity and productivity in relation to succession and development. Urban, rural and other Man-made ecosystems, their impact on animal life. Urbanization and indsutrialisation. Socio-ecological impacts.
Unit VII	Air Pollution Air Pollution: Types and major sources of air pollutants, effects of air pollutants on physico-chemical and biological properties surrounding atmosphere, air born diseases and their effects on health.
Unit VIII	Water Pollution Water Pollution: Types and major sources of water pollutants, effects of water pollutants on physico-chemical and biological properties of water bodies, water born diseases with special reference to water pollution.
Block 2	Environmental Biology-III
Unit IX	Soil Pollution Soil Pollution: Types and major sources of soil pollutants, effects of soil pollutants on physico-chemical and biological properties of soil. Air, drinking water and waste water

	quality standard.
Unit X	Noise Pollution & Radioactive and Thermal Pollution Noise Pollution: Major sources of noise pollution, effects of noise pollution on health, noise level standard in industrial, commercial, residential and silence zones. Radioactive and thermal pollution sources and their effects on surrounding environment. Solid waste disposal and its effects on surrounding environment
Unit XI	Biodiversity Conservation Introduction to biodiversity concepts, significance, magnitude and distribution. Biodiversity trends, diversity gradients and related hypotheses methods for monitoring biodiversity trends. Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book. Strategies for biodiversity conservation, National parks, Sanctuaries and biospheres reserve. Principles of biodiversity conservation in-situ and ex-situ conservation strategies. Aquatic common flora and fauna in India. Phytoplankton, Zooplankton and microphytes Terrestrial common flora and fauna in India- forest endangered and threatened species.
Unit XII	Environmental Economics World environmental history and economic development, valuation of natural resources, sustainable agriculture and development, cost benefit analysis, current moral and philosophical problems of traditional and technological societies, investment projects and natural resources. Economics of recycling and waste management.
Suggested Text Book Readings:	
1. Chapman, J.L. and Reiss, M.J. 1998, Ecology Principles and Applications (2nd Edition), Cambridge University Press, U.K. 2. Odum, E.P. and Barrett, G.W., 2005, Fundamentals of Ecology, Thomson Books/Cole, U.S.A. 3. Sharma, P.D., 2011, Ecology and Environment, Rastogi Publ. Meerut. 4. Singh, J.S., Singh, S.P. and Gupta, S.R., 2006, Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: III
Subject: Biology		
Course Code: PGZY-113	Course Title: Tools and Techniques	
Course Objectives: The aim of this course is to familiarize students about tools and techniques which will help them in scientific studies of the subject.		
Course Outcomes: (CO): On successful completion of this course students will be able to: • know analytical instruments and spectrometry • understand centrifugation, electrophoresis, chromatography & microscopy. • Know auto radiography, micro-technique, micro-photometry, monometry and osmometry.		
Credits: 04	Type of Course: Core (√) /Elective	
Max. Marks: 100	Min. Passing Marks: 36	

(Syllabi should be framed block wise/unit wise; No of blocks and units may change)	
Block 1	Tools and Technique-I
Unit I	Analytical instruments- Principal and applications of Balances Sorensen's PH scale PH meter-Calomel, glass and combined electrode
Unit II	Spectrophotometry- Principal and applications of Colorimeter- Lambert's Beer law Spectrophotometer- theory and instrument Nuclear magnetic resonance (NMR) Raman Spectroscopy.
Unit III	Centrifugation Principle and type of centrifugations Types of rotors and their uses Ultracentrifugation: Types and uses
Unit IV	Electrophoresis- Principles and applications of Gel Electrophoresis PAGE and SDS PAGE 2D- Gel Electrophoresis
Unit V	Chromatography- Principles and applications of Paper Chromatography Thin layer Chromatography High Performance Liquid Chromatography (HPLC)
Unit VI	Microscopy- Principles and applications of Light and Phase Contrast microscopy Dark field and Fluorescence microscopy Electron microscopy- TEM and SEM
Block-2	Tools and Technique-II
Unit VII	Autoradiography- Principles and applications - Radioactivity, radioactive materials and their half-life Methods of autoradiography Applications with examples
Unit VIII	Microbiological techniques Media Preparation & sterilization Inoculation and growth monitoring Cell culture techniques
Unit IX	Micro-technique – Theory of fixation and important fixatives, storage of fixed materials, killing, Fixation, embedding and section cutting in serial, rocking and rotary microtomes, Stains and Dyes: Haematoxylin, safranin, fast-green and carmine, use of camera lucida, use of pH meter, oven, Incubator, autoclave and ultraviolet lamp.
Unit X	Micro-photometry Principle of micro-photometry Ocular and stage micrometers Calibration and measurements
Unit XI	Manometry Types of manometer- Piezometer, U-tube and advanced U-tube Measurement of Oxygen by manometer Warburg manometer
Unit XII	Osmometry Vant Hoff's law of osmotic pressure Determination of osmotic pressure Types of osmometers and their applications
Suggested Text Book Readings: 1. Tools & Techniques in Biology by Umaiyal Munusamy. 2. Biological Tools & Techniques by Ananta Swargiary. 3. Life Science in tool and techniques by P.S. Bisen/ Shruti Mathur. 4. Techniques and methods in Biology by K.L. Ghatak	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: Basics in Research			
Programme: M.Sc./M.A.		Year: II	Semester: III
Subject: Statistics			
Course Code: <i>PGRT-03</i>		Course Title: <i>Basics Research Tools</i>	
Course Objectives: The main objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of basic computer tools, research tools, indexing of research paper and scientific report writing.			
Course Outcomes:			
CO1: To know about the research tools and indexing of a research paper.			
CO2: To know about the fundamentals of basic computer tools and how to use it in research.			
CO3: Able to know the writing the research paper and scientific report writing.			
Credits: 4		Type of Course: Core	
Max. Marks: 100		Min. Passing Marks: 36	
Block 1	Introduction		
Unit 1	MEASURES OF CENTRAL TENDENCY MEASURES: Introduction, Definition. Objectives of Average . Characteristics of Good Average . Types of Average. Arithmetic Mean. Weighted Arithmetic Average . Median . Mode . Geometric Mean . Harmonic Mean		
Unit 2	MEASURES OF DISPERSION: Introduction. Definition . Objectives of Measuring Dispersion. Different Measures of Dispersion. Range . Standard Deviation . Lorenz Curve . Skewness . Kurtosis		
Block 2	PROBABILITY		
Unit 3	PROBABILITY – 1: Introduction . Meaning and Definition of Probability. Probability Defined. Experiment. Sample Space (S). Event. Types of events in probability. Probability Measure. Probability Rules:. Probability Theorems. Addition Theorem. Multiplication Theorem		
Unit 4	PROBABILITY 2: Conditional Theory. Key Concepts of conditional theory. Applications of conditional theory . Bayes' Theorem. Application of Bayes' Theorem. . Theoretical distribution . Uses of Theoretical Distributions. Types of Theoretical Distributions. Benefits Of Theoretical Distributions. Introduction. Binomial Distribution in Statistics . What Is The Binomial Distribution Formula?. Assumption For Binomial Distribution . Common Applications of Binomial Distribution. Poisson Distribution. Key Characteristics of Poisson distribution. Probability Mass Function (PMF). Applications of Poisson distribution. Assumptions of Poisson distribution. Common Uses of Poisson distribution. How to Solve Problems of Poisson distribution?		
Unit 5	PROBABILITY 3: Introduction;. Binomial Distribution in Statistics . What Is The Binomial Distribution Formula?. Assumption For Binomial Distribution . Common Applications of Binomial Distribution. Poisson Distribution, Key Characteristics of Poisson distribution, Probability Mass Function (PMF), Applications of Poisson distribution, Assumptions of Poisson distribution, Common Uses of Poisson distribution, How to Solve Problems of Poisson distribution?, Introduction, Key Characteristics of Normal Distribution, Properties of Normal Distribution, Application of Normal Distribution, Types of Normal Distribution		
Block 3	SAMPLING		
Unit 6	SAMPLING: Introduction: Meaning of Sampling, Need of Sampling, Advantages of Sampling, Limitations of Sampling		

Unit 7	SAMPLING METHODS OF DATA COLLECTION: Sampling, Data Collection, Methods For Collecting Statistical Data , Types Of Data, Primary And Secondary Data, Primary Data, Secondary Data
Unit 8	SAMPLING DISTRIBUTION: Probability and Non-Probability Sampling, Sampling Techniques, Probability or Random Sampling, Simple Random Sampling, Stratified Sampling , Systematic Sampling , Cluster Sampling, Area Sampling, Probability-proportional-to-size sampling, Double Sampling and Multiphase Sampling, Non-probability or Non Random Sampling, Quota sampling, Convenience or Accidental sampling, Purposive (or judgment) Sampling, Snow-ball Sampling
Unit 9	SOURCES OF DATA COLLECTION: Introduction: Meaning and Importance of Data, Primary Sources of Data, Advantages of Primary Data, Disadvantages of Primary Data, Methods of Collecting Primary Data, Secondary Sources of Data, Features and Uses of Secondary Data, Advantages of Secondary Data, Disadvantages of Secondary Data, Methods of Collecting Secondary Data, Difference between Primary Data and Secondary Data, Questionnaire and Schedule Construction, Basic Rules for Questionnaire Item Construction
Block 4	STATISTICAL INVESTIGATION AND ESTIMATION
Unit 10	STATISTICAL ESTIMATION: Introduction, Point estimation , Types of point estimators , Properties of point estimator, Point estimation methods , Advantages of Point estimation:, Disadvantages of Point estimation , Errors in Point Estimation, Uses of Point Estimation , Interval estimation Types of Interval estimation, Properties of Interval estimation, Interval estimation methods , Advantages of Interval estimation, Disadvantages of Interval estimation, Errors in Interval estimation, Uses of Interval estimation
Unit 11	SAMPLING TEST: Introductions , Types of Sampling , Sampling Methods, Sampling Test Statistics: Hypothesis Testing:, Common Sampling Tests, Large sample, Benefits of Large sample, Limitation of Large Sample , Test for large sample , Some specific tests for large samples include , Small Sample , Benefits of Small Sample, Limitations of Small Sample, Types of Small Sample , Test For Small Sample
Unit 12	HYPOTHESIS TESTING: Introduction or Conceptual Framework of Hypothesis, Uses of Hypothesis, Scientific Hypothesis, Measures of Hypothesis, Statistical Hypothesis testing, Hypothesis Error
Unit 13	NON PARAMETRIC TEST: Non parametric test, Wilcoxon rank-sum test (Mann-Whitney U test), The Wilcoxon signed-rank test, The Kruskal-Wallis H test, Spearman's rank correlation, Chi-square test
Block 5	Statistical Tools
Unit 14	CORRELATION AND REGRESSION: Introduction, Definitions, Types of Correlation, Methods of Determining Correlation, Calculation of Coefficient of Correlation, Rank Correlation, Regression, Utility of Regression, Methods of Studying Regression, Regression Equation, Comparison of Correlation and Regression
Unit 15	STATISTICAL QUALITY CONTROL (SQC): Introduction, Key components of SQC, Benefits of SQC, Uses of SQC, Limitations of Statistical Quality Control, Functions of Statistical Quality Control
Unit 16	CONSTRUCTION OF CONTROL CHARTS: Introduction to Control Charts, Key Components of a Control Chart,How Control Charts Work, Types of Control Charts, Construction of Control Charts, Formula to calculate control chart,Control Chart Constants
Unit 17	CHI SQUARE TEST: Introduction, Chi-Square as Non-Parametric Test, Test of Goodness of Fit

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: IV
Subject: Biology		
Course Code: PGZY-116		Course Title: Fisheries
Course Objectives: An important part of the main objective of the course related to functional physiological mechanisms, the course is also adopted to the fish biology, ecology, fish pathology and fish taxonomy.		
Course Outcomes: (CO): At the end of the course the students will be able to: • Learnt the general classification of fishes, economically important marine and freshwater fishes. • Described recent concepts in fish biology and physiology, ecology and pathology. • Came to know the various aquaculture systems. • Understood the type of hatchery, brood stock, larval production, feed management water quality and disease management in cultivable species, live feed production. • Described the taxonomy of fishes.		
Credits: 04		Type of Course: Core (√) /Elective
Max. Marks: 100		Min. Passing Marks: 36
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Fish Biology-I	
Unit I	Fish Biology-I Geographical distribution: Classification of fishes, with distinguishing characters of principal subdivisions. Status and conservation of fish fauna of India. General account and phylogenetic significance of Ostracoderms and Placoderms. Origin and adaptive radiation of various groups. Body form and locomotion.	
Unit II	Fish Biology-II Integument, exoskeleton and colouration of fishes. Structure, modification and functions of median and paired fins. Theories of origin of median and paired fins. Musculature: Lateral musculature, jaw and respiratory musculature, fin musculature and eye muscles, Weberian apparatus.	
Block-2	Fish Physiology	
Unit III	Physiology-I Food, feeding habits, alimentary canal and physiology of digestion. Blood, heart, vascular system and circulation of blood. Haemoglobin and its adaptation in fishes. Respiratory organs, physiology of respiration and its regulation. Air breathing organs.	
Unit IV	Physiology-II Excretory organs and physiology of excretion. Nervous system and sense organs, lateral line system.	
Unit V	Physiology-III Osmoregulation in marine, fresh water and estuarine fishes. Sense organs: Eye, Olfactory and Lateral Line System	
Unit VI	Physiology-IV Reproduction and reproductive organs. Endocrine glands and caudal neuro secondary system	
Block-3	Fish Ecology and Uses	
Unit VII	Fish Ecology	

	Construction and Lay-out of different types of Ponds (Nursery, Rearing and stocking) Formulation and Operation of different types of Hatcheries Water Quality Requirements of Toxic substances Temperature, salinity, osmotic pressure, pH, dissolves oxygen, carbon dioxide, nitrogen, alkalinity and turbidity Toxic substances and their effects Productivity of the Pond (Planktons and Live food organism)
Unit VIII	Capture Fisheries Freshwater Fisheries (River, Lakes and Reservoir) Cold water Fisheries and Hill Stream Adaptation Brackish water Fisheries Marine Fish resources of India, Exclusive Economic Zone
Unit IX	Breeding habits of Carps Breeding habits of Carps: Induced Spawning and Bundh Breeding of Carps (Indigenous and Exotic) Pond Management and Stocking Materials: Mannering, Liming, Predatory and Weed Fishes and their Eradication, Predatory Aquatic Insects and their Control, Fish Poison, Stocking Materials (Spawn, Fry and Fingerlings) and their culture
Unit X	Fish Products and Fish Diseases Fish Preservation and Processing (Traditional and Advanced Method) Fish By-Products Fish Marketing and Trade Fisheries Cooperative Societies of India Aquarium Fish and their Maintenance
Unit XI	Fish Pathology Fish Pathology: Prevention, Prophylaxis and Treatment of Fungal, Bacterial, Viral and Protozoan Diseases Fish in relation to Man and Human Welfare
Unit XII	Fish Taxonomy Classification of fish up to orders as proposed by L.S. Berg (1940) Systematics/Taxonomy study of marine and freshwater fishes with special reference to identification of local forms (up to families) (A) Marine fishes- 1- Order Clupeiformes Family-Clupeid eg. <i>Sardinella fimbriata</i> (oil sardine) 2- Order Perciformes - Family 1. Scombridae eg. <i>Rastrelliger kangurita</i> (Mackerel Fish) 2. Stromateidae eg. <i>Stromateus argenteus</i> (Pomfrets) 3- Order- Scombroideiformes family- Harpodonidae eg. <i>Harpodon nehereus</i> (Bombay duck) (B) Freshwater fishes 1- Order-Clupeiformes. Families-<i>Clupeidae</i> <i>Notopteroidae</i> 2- Order-Beloniformes, Families – <i>Belonidae</i> <i>Hemiramphidae</i> 3- Order- Mastacembeliformes family- Mastacembelidae 4- Order- Mugiliformes family- Mugilidae
Suggested Text Book Readings: 5. Text book of Fish Biology & Fisheries by S.S. Khanna 6. Hand book of Indian Fisheries and Aquaculture by Jayanta Kumar Mukherjee. 7. Fish and Fisheries by Pandey and Shukla. 8. Phylogeny and Systematics of Fishes by A.C. Gill, R.D. Mooi.	
This course can be opted as an elective by the students of following subjects: NA	

Suggested equivalent online courses (MOOCs) for credit transfer: NA		
Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: IV
Subject: Biology		
Course Code: PGZY-117	Course Title: Entomology	
Course Objectives: Insect diversity society and evolution introduce students to the various orders and some families of insects which form the basis of entomology. Insect Physiology is the study of the properties, processes and functions of insect systems. The Entomology also describes adverse effects of pesticides and management of crop pests.		
Course Outcomes: (CO): At the end of the course the students will be able to:		
• Following completion of this course, they would acknowledge the value and importance of insects and the students would be able to sight identify different orders of insects. They will also know the basic biology and the significant identification characters of the insects. • Become familiar with the various physiological systems operating in insects. Develop asense of how physiology can be infused in major research to pics in entomology. • The students having this course will study various types of insecticides and understand their mode of action to kill/control the insects. The students will understand their crucial role in ecosystems and their biota. May appreciate the insects as bio-indicators of ecological changes/disturbances. • Entomology plays a major role in training students in understanding the interaction of nature, plants and insects in order to ensure crop protection by controlling economically important insect pests of various crops and bio-rational methods in an integrated approach (IPM)		
Credits: 04	Type of Course: Core (√) /Elective	
Max. Marks: 100	Min. Passing Marks: 36	
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Origin and Evolution and Morphology of insects	
Unit I	Origin and Evolution of insects Origin and evolution of insects, relationships between entognathous and ectognathous apterygotes.	
Unit II	Morphology of Insects Insect integument: Structure, composition and functions. Biochemistry of sclerotisation. Functional morphology: Head, thorax, abdomen and appendages, head segmentation, wing venation. Muscular system and its functions.	
Block-2	Insects Physiology	
Unit III	Digestive and Circulatory System Digestive system: Alimentary canal and physiology of digestion. Circulatory system: Anatomy, physiology; composition of haemolymph	
Unit IV	Respiratory and Excretory System Respiratory system: Structure and physiology. Excretory system: Functional architecture.	
Unit V	Nervous and Neuro endocrine system. Nervous system: Structure and physiology. Neuro-endocrine system.	
Unit VI	Sense Organs Sense organs: Chemoreceptors, mechanoreceptors, photoreceptors, sound and light producing organs, visual organs and physiology of vision. Reproductive system: Structure and physiology.	
Block-3	Insects Classification	

Unit VII	Classification of Insects- I Classification of insects up to order and suborders. Comparative study of wing venation in Orthoptera, Hymenoptera (Apis), Diptera (mosquito) and Homoptera (Aphid). Introduction to primitive insects and fossil insects, cause of success of insects.
Unit VIII	Classification of Insects-II Detailed classification of the following orders emphasizing selected superfamilies and families: Orthoptera, Isoptera, Coleoptera, Homoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera. Economic importance of these orders.
Block 4	Applied Entomology and Pest Management
Unit IX	Social Life of Insects Social life in Isoptera and Hymenoptera. Caste determination in social insects.
Unit X	Pest Management-I Characteristics features, biology, nature of damage and management measures of: Important insects pests of cotton, Important insects pests of sugarcane, Important insects pests of vegetables, Important insects pests of oil seeds, Important insects pests of fruit crops, especially mango.
Unit XI	Pest Management-II Characteristics features, biology, nature of damage and management measures of: Important insects pests of cereals and pulses, important insects pests of stored grains, Polyphagous insects,
Unit XII	Industrial Entomology Apiculture, Sericulture and Lac-culture.
Suggested Text Book Readings: 1. A general text book of entomology, Imms,A.D.,Chapman & Hall,UK 2. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, 3. N. F.,M Saunders College Publication,USA 4. Principles of Insect Morphology, Snodgrass, R.E.,Cornell Univ. Press,USA 5. The Principles of Insect Physiology, Wigglesworth, Vincent B, Chapman & Hall Ltd.USA. 6. The Insects: Structure and function, Chapman, R. F., Cambridge University Press,UK 7. Physiological system in Insects,Klowden,M.J.,Academic Press,USA	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: IV
Subject: Biology		
Course Code: PGZY-120	Course Title: Cytogenetics	
Course Objectives: The main objectives of the course is how the chromosomes related to cell behavior, particularly to there behavior during mitosis and meiosis.		
Course Outcomes:(CO): At the end of the course the students will be able to: • The students will be able to recognize describe and discuss in the chromosomes and chromatin structure, cell cycle and chromosomal abnormalities. • Also describe in the human cytogenetics and cytogenetics of cancer.		
Credits: 04	Type of Course: Core (√) /Elective	
Max. Marks: 100	Min. Passing Marks: 36	
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Chromosome organization	
Unit I	Chromosome structure Metaphase chromosome: centromere and kinetochore, telomere and its maintenance; Holocentric chromosomes and supernumerary chromosomes	
Unit II	Chromatin structure Histone proteins- types and chemical nature, Non-histone proteins, Nucleosome structure and higher level organisation Chromosomal domains (matrix, loop domains) and their functional significance	
Unit III	Heterochromatin Heterochromatin and euchromatin, position effect variegation, boundary elements, Junk DNA, Micro- and Mini satellites, Significance of hetrochromatin	
Unit IV	Giant chromosomes Polytene chromosomes Lampbrush chromosomes	
Block-2	Insects Classification	
Unit V	Mitosis Overview of mitosis, Mitotic spindle and arrangement of chromosomes on equator Regulation of exit from metaphase Chromosome movement at anaphase	
Unit VI	Meiosis Overview of meiosis Meiosis specific cellular changes Genetic control of meiosis	
Unit VII	Chromosomal anomalies Numerical Structural Induced chromosomal aberrations in somatic cells Sister chromatid exchanges and crossing over	
Unit VIII	Dosage compensation Epigenetic modification, X-chromosome inactivation, Barr body. Dosage compensation in <i>C. elegans</i> , <i>Drosophila</i> and Mammals	
Block 3	Chromosome behaviour and Cancer	
Unit IX	Human Cytogenetics Human karyotype- study and analysis Chromosome bandings- G-banding, C-banding and their significance. Chromosome nomenclature Mendelian and chromosome based heritable diseases in humans	

	Human Genome
Unit X	Sex determination Chromosomal theory of sex determination, X and Y- chromosome Gynandromorphs, Intersexes and Supersexes in <i>Drosophila</i> , Genetics basis of sex determination in <i>Drosophila</i> and Human
Unit XI	Linkage and Crossing over Linkage and Crossing over Crossing over and chromosome behaviour Linkage groups and chromosomes Recombination and crossing over Cytological demonstration of crossing over
Unit XII	Chromosome Aberrations and Maps Classifications of chromosomal aberrations Duplication, inversion, and translocation Syndromes related to Trisomics and Monosomics
Unit XIII	Cytogenetics of Cancer Types and biology of cancer Genetic basis and chromosomal abnormalities. Proto-oncogenes Tumor suppressor genes
Suggested Text Book Readings: 1. Gardner, E.J.; Simmon, M.J. and Snustad, D.P. Principles of Genetics, John wiley & Sons, inc. NY 2. Weaver, R.F. and Hedrick, P.W. Genetics. Wm C. Brown Publishers. 3. Brown, T.a. Genetics- A Molecular, Approach, Chapman & Hall. 4. Mitra, S. Genetics-A Blueprint of life, Tata McGraw Hill 5. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. 6. Dobzhansky, Th; Ayala, F.J.; Stebbins, G.L. and Valentine, J.M. Evolution, Surjeet Publihsers, Delhi. 7. Futuyama, D.J. Evolutinary Biology, Suinuaer Associations. INC Publishers. Dunderand. 8. King, M. Species, Evolution –The role of chromosomal change. The Cambridge University Press, Cambridge. 9. Merrel, D.J. Evolution and Genetics Holt. Rinchart and Winston, Inc. 10. Strikberger, M.W. Evolution Jones and Barlett Publishers. Boston London.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: IV
Subject: Biology		
Course Code: PGZY-121	Course Title: Genetic Engineering	
Course Objectives: The main objective of genetic engineering is locating an organism with a specific trait and extracting its DNA and cloning a gene that controls the trait.		
Course Outcomes:(CO): At the completion of this course the students will be able to:		
• Basic molecular biology and Isolation of DNA and RNA • Gene cloning and PCR • DNA finger printing • Immuno-technology and transgenic animals.		
Credits: 04	Type of Course: Core (√) /Elective	
Max. Marks: 100	Min. Passing Marks: 36	
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Materials and Tools - I	
Unit I	Introduction History of genetics Basic molecular biology- gene expression in prokaryotes and eukaryotes	
Unit II	Working with nucleic acids Isolation of DNA and RNA Radio-labelling of nucleic acids- end labelling, nick translation, by primer extension Principle of nucleic acid hybridization DNA sequencing methods- Maxam-Gilbert and Sanger-Coulson sequencing	
Unit III	Enzymes as tools Restriction enzymes- Type II, uses and restriction mapping DNA modifying enzymes- Nucleases, Polymerases, and end-modifying enzymes DNA ligases	
Block-2	Genetic Engineering- II	
Unit IV	Cloning vectors Plasmids- pBR322, pUC8 Lambda (λ)-phage vector, M13 Phage, Cosmids, Phasmids, Shuttle vector. Bacterial artificial chromosome (BAC), Yeast artificial chromosome (YAC), Mammalian artificial chromosome (MAC)	
Unit V	cDNA and its applications Synthesis of cDNA from mRNA Cloning cDNA in plasmid and bacteriophage vectors Expression of cloned cDNA molecules, cDNA library	
Unit VI	Cloning from genomic DNA Genomic DNA and library Preparation of DNA fragment for cloning Ligation, packaging and amplification of libraries	
Unit VII	Polymerase chain reaction (PCR) Basic PCR RT (reverse transcribed)- PCR Real Time PCR Applications of PCR in genetic engineering	
Unit VIII	DNA Finger printing History, DNA markers, Minisatellites, Microsatellites Methods and applications	

Unit IX	Screening and analysis of recombinants Use of chromogenic substrates Genetic selection methods Nucleic acid probes- Chromosome walking and jumping Screening cloned banks Immunological screening for expressed genes Blotting techniques
Block 3	Genetic Engineering-II
Unit X	Genetic engineering in action Analysis of gene structure and function Techniques- Gel retardation, DNA foot-printing, DNA finger printing, Primer extension, S ₁ mapping, and Dot-blot analysis.
Unit XI	Immunotechnology Hybridoma technology Monoclonal antibodies and its production Antibody engineering Uses of monoclonal antibodies
Unit XII	Transgenic animals Transgenic animals Vs cloned animals Producing transgenic animals Applications of transgenic animals
Suggested Text Book Readings: 1. Principles of Biotechnology and Genetic Engineering by Dr. A.J. Nayar 2. Genetic Engineering by Smita Rastogi & Neelam Pathak. 3. Genetic Engineering by Grubachan S. Miglani. 4. An Introduction to Genetic Engineering by Desmond S. T. Nicholl. 5. Alberts, B., and Johnson, A., 2016, Molecular Biology of Cell, Garland Science Publisher. 6. Lodish, et. al., 2013, Molecular Cell Biology, 7th Edition, W.H. Freeman Publisher. 7. Russell, P.J, 2006, Genetics (5th Ed.), Addison Wesley Longman, California, USA. 8. Snustad, P., and Simmons, M.J, 2011, Principles of Genetics. (6th Ed.), John Wiley, New York. 9. Robertis, EDP De & Robertis, EMF De, 2002, Cell and Molecular Biology (8th Edition), Lippincott Williams & Wilkins International Student Edition, Philadelphia.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: IV
Subject: Biology		
Course Code: PGBY-118	Course Title: Bioinformatics	
Course Objectives: This course has a strong interdisciplinary component and is designed to equip students with essential skills in bioinformatics (at basic level).		
Course Outcomes:(CO): On successful completion of this course, the students will be able to: • Get introduced to basic tools and concepts of Bioinformatics and their significance in applied and basic biology. They will also learn application of various bioinformatics tools, biodiversity databases and biological resources. • Learn about various biological databases and bioinformatics tools. • Learn about genome and model organisms. • Get introduced to gene prediction, phylogenetics and proteomic data analysis.		
Credits: 04	Type of Course: Core (√) /Elective	
Max. Marks: 100	Min. Passing Marks: 36	
(Syllabi should be framed block wise/unit wise; No of blocks and units may change)		
Block 1	Basics of Bioinformatics	
Unit I	Introduction and scope of bioinformatics	
Unit II	Basics of computers (CPU, I/O units) and operating systems	
Unit III	Internet resources- • Internet, Concept of home pages and web-sites • World Wide Web, Uniform Resource Locators • Search engines and searching Internet for the information, NCBI, PubMed	
Block 2	Genome and Model organisms	
Unit IV	Functional genomics • Genome mapping- Genetic maps, DNA markers, RFLPs, SNPs, Linkage analysis, chromosomal maps, sequence Tagged sites (STS), and ESTs.	
Unit V	Study of Model organisms • <i>Caenorhabditis elegans</i>- life cycle, overview of genome • <i>Drosophila sp.</i>- life cycle, Polytene chromosome and overview of genome • Mouse- Overview of genome • Human- Overview of genome	
Block-III	Databases and Retrieval of Data	
Unit VI	Biological data bases • Contents, structure and annotation: Database in bioinformatics, primary and secondary databases • File formats • Annotated sequence database • Genome and organism-specific database • Life sciences databases • Database resources- GenBank, EMBL, SWISS-PROT, OMIM	
Unit VII	Retrieval of database • Data retrieval with Enttez and DBGET/ Link DB • Data retrieval with Sequence retrieval system (SRS)	
Unit VIII	Searching sequence data base	

	• Sequence similarity searches • Amino acid substitution matrices • Database searches- FASTA and BLAST Sequence filters
Unit IX	Name and Function of Database • DNA/ RNA databases • Protein sequence database, • Protein structure database • Protein domains and Motifs • Model organisms databases and resources
Unit X	Methods of gene prediction • Finding of gene, exons • Gene prediction programs and their examples • Gene prediction methods • Promoter recognition program and Pattern search
Unit XI	Phylogenetics • Phylogenetics, cladistics and ontology • Building phylogenetic trees • Evolution of macromolecular sequences
Unit XII	Proteomic data analysis • Analysing data from 2-D PAGE gels • Analysing protein mass spectrometry data
Suggested Text Book Readings: 1. Attwood, T.K. and Parry-Smith, D.J., 2004, Introduction to Bioinformatics, Pearson Education, Singapore, Pvt. Ltd. 2. Dwyer, R.A., 2004, Genomic Perl: From Bioinformatics Basics to Working Code, Cambridge University Press, 1st south Asian edition. 3. Edwards, D., 2007, Plant Bioinformatics: Methods and Protocols, Humana Press, New Jersey, USA.	
This course can be opted as an elective by the students of following subjects: NA	
Suggested equivalent online courses (MOOCs) for credit transfer: NA	

Course prerequisites: To study this course, a student must have qualified graduation with Zoology		
Programme: M.Sc.	Year: II	Semester: IV
Subject: Zoology		
Course Code: PGZY-123 N (D)	Course Title: Dissertation and Viva-voce	
Course Objectives: In the last semester of Masters the main objective of the exposure of students towards project/dissertation is to elevate their understanding into the practical and experimental aspects of some targeted areas of chemistry. This course will develop their analytical ability and will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in chemical sciences.		
• Course Outcomes: • Students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame. • It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of assigned project. • In addition, students will be able to know the library search and handle the data in a meaningful way. • Also, students will be able to interpret the spectral data independently. • Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.		
Credits: 04	Type of Course: Core	
Max. Marks: 100	Min. Passing Marks: 36	
References: For project work and dissertation, the area of the work would be to be decided by the advisor/mentor. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members.		

APPENDIX-II

Guidelines for preparing Research Project/Dissertation is available at link:

http://14.139.237.190/upload_pdf/01_02_2023_Guidelines_fo_Project_Lit_Survey_Dissertation.pdf