Master of Science

Zoology

Syllabus

Faculty of Science

MAULANA AZAD UNIVERSITY, JODHPUR

M.Sc. Zoology

Schemes for Internal Assessments and End Semester Examinations Semester-wise

Semester	Subject Code	Paper	CIA-I	CIA-II	ESE	Total
I Sem.	MSZO 111	Biosystematics & Evolution	10	10	80	100
	MSZO 112	Structure & Function of Invertebrates	10	10	80	100
	MSZO 113	Vertebrate Physiology-I	10	10	80	100
	MSZO 114	Ecology and Animal Behavior	10	10	80	100
	MSZO 121	**Zoology Lab-I**	10	10	80	100
II Sem.	MSZO 211	Developmental Biology	10	10	80	100
	MSZO 212	Microbiology	10	10	80	100
	MSZO 213	Vertebrate Physiology-II	10	10	80	100
	MSZO 214	Quantitative Biology	10	10	80	100
	MSZO 221	**Zoology Lab-II**	10	10	80	100
III Sem.	MSZO 311	Chordate Biology-I	10	10	80	100
	MSZO 312	Vertebrate Immunology and Animal Cell Culture	10	10	80	100
	MSZO 313	Environmental Biology-I / Entomology-I (Insect- Structure & Function)	10	10	80	100
	MSZO 314	Environmental Biology-II / Entomology-II (Systematics, Ecology And Economic Entomology)	10	10	80	100
	MSZO 321	**Zoology Lab-III**	10	10	80	100
	MSZO 322	**Zoology Lab-IV**	10	10	80	100
	MSZO 323	**Zoology Lab-V**	10	10	80	100
IV Sem.	MSZO 411	Chordate Biology-II	10	10	80	100
	MSZO 412	Applied Zoology – Its Tools And Techniques	10	10	80	100
	MSZO 413	Environmental Biology-I / Entomology-I (Insects- Function And Development)	10	10	80	100
	MSZO 414	Environmental Biology-II / Entomology-II (Systematics, Agriculture Entomology And Pest Management)	10	10	80	100
	MSZO 421	**Zoology Lab-VI**	10	10	80	100
	MSZO 422	**Zoology Lab-VII**	10	10	80	100
	MSZO 423	**Zoology Lab-VIII**	10	10	80	100

Semester-I		
MSZO 111: Biosystematics & Evolution		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Biosystematics • Definition • Importance of Biosystematics • Applications of Biosystematics in Biology ➢ Neotaxonomy – Consequences of New Systematic • Chemotaxonomy - ❖ Kinds o Immunological Approach o Chromatographic Approach o Histo-chemical Approach ➢ Cytotaxonomy – • Chromosomal behaviour ❖ Karyotype test ❖ Chromosome number ❖ Chromosome morphology ❖ Linkage, recombination , frequency analysis • Banding pattern – G,C,R,Q Banding ➢ Molecular Taxonomy • Source of variation, satellite DNA (Mini and micro DNA) • Molecular markers –RFLP, RAPD, and AFLP • Ribotyping and DNA sequencing	09
II	➢ Taxonomic Procedure - • Collection - ❖ Value of Collection ❖ Purpose of Scientific Collection ❖ Collecting & Research ❖ Scope of Collection ❖ Where & How to Collect ❖ Content of Collection ❖ Preservation - ❖ Introduction ❖ Process of Preservation ❖ Preservation of invertebrates and vertebrates (Basic Idea) ➢ Curating - ❖ Preparation of Material for Study ❖ Housing ❖ Cataloging ❖ Arrangement of Collection ❖ Curating of types ❖ Exchange of Material ❖ Expendable Material ➢ Taxonomic Keys – Types • Indented Key • Bracket Key • Ground Types	09

	• Pictorial Type • Branching Type • Circular Type ➢ Box Type	
III	➢ International code of Zoological nomenclature ➢ Principles - • Principle of Binominal Nomenclature • Principle of Priority • Principle of Coordination • Principle of the First Reviser • Principle of Homonymy • Principle of Typification ➢ Structure ➢ Gender agreement ➢ Commission ➢ Species Indices - • Shannon – Weiner Index • Dominance Index • Similarity & Dissimilarity • Association Index	09
IV	➢ Modern Theory of Evolution ➢ Lamarcks Theory and Neo Lamarckism ➢ Theory of Catastrophism ➢ Theory of Darwin and Neo Darwinism ➢ Weismann's Theory ➢ Modern Synthetic Theory ➢ Isolation & Isolating Mechanism • Definition • Pre-mating Mechanism - • Geographic isolation • Isolation due to distance • Climatic isolation • Seasonal isolation • Habitat isolation • Ethological isolation • Mechanical isolation • Physiological isolation ➢ Post-mating Isolation – ➢ Gametic Mortality ➢ Zygotic Mortality ➢ Hybrid Inviability ➢ Hybrid Sterility ➢ Origin of Reproductive Isolation- ➢ Muller's view ➢ Dobzhansky's View ➢ Speciation - • Modes of Speciation ❖ Phyletic Speciation ❖ Quantum Speciation ❖ Gradual Speciation	09

	➢ Evolution of Man – ➢ Pre human ancestors ➢ Evolution of man in Pleistocene	
V	➢ Variation – • Kinds of Variation- ➢ Meristic & substantive ➢ Continuous & Discontinuous ➢ Determinate & Indeterminate ➢ Somatic & Germinal • Sources of Variation • Basis of Variation – ➢ Chromosomal Aberration ➢ Variations in chromosome number ➢ Natural Selection – • Types – ❖ Stabilizing selection ❖ Directional Selection ❖ Disruptive Selection ➢ Selection Pressure ➢ Genetic Drift – ➢ Theory of genetic Drift ➢ Salient Features of Genetic Drift ➢ Genetic basis of Random Genetic Drift ➢ Hardy-Weinberg equilibrium & Genetic Drift ➢ Mimicry – • Kinds – ❖ Protective ❖ Aggressive ❖ Conscious ❖ Significance of Mimicry	09

RECOMMENDED READINGS

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Semester-I		
MSZO 112: Structure & Function of Invertebrates		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Organization of Coelom ➢ Evolution of Coelom (Various Theories) ➢ Modification of Coelom ➢ Significance of Coelom ➢ Acoelomate ➢ Pseudocoelomate ➢ True Coelomate ➢ Metamerism – Types, Origin and Evolution ➢ Difference between Protostomia and Deuterostomia	09
II	➢ Nutrition, Feeding, Structure and physiology of Digestion • Protozoa • Platyhelminthes (Class Turbillaria) • Annelida (Class Polychaeta) • Arthropoda (Class Insecta) • Mollusca (Class Cephalopoda) • Echinodermata	09
III	➢ Different types of Respiratory organs in Invertebrates- their structure and functions • Gills • Lungs • Trachea ➢ Respiratory Pigments (Specific to invertebrates only)	09
IV	➢ Different types of Excretory organs in Invertebrates- their structure and functions • Nephridia • Malphigian Tubules ❖ Brief idea about accessory excretory organs • Coaxial Glands • Kebers Organ • Bojanus Organ ❖ Mechanism of Excretion	09
V	➢ Nervous System • Primitive Nervous System ❖ Echinodermata • Advanced Nervous System ❖ Annelida (Class Oligochaeta) ❖ Arthropoda (Class Insecta) ❖ Mollusca (Class Cephalopoda)	09

RECOMMENDED READINGS

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Semester-I		
MSZO 113: Vertebrate Physiology-I		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Digestion: • Digestive glands and alimentary canal • Digestive enzymes and their secretion • Digestion of Protein, Fat and Carbohydrate ➢ Vitamins • Types • Sources • Physiological Functions • Diseases Caused By Deficiency	09
II	➢ Respiration ➢ Respiratory Organs Structure – Structure of lungs ➢ Mechanism of Breathing- • Inspiration • Expiration ➢ Exchange and Transport of Gasses- • Oxygen dissociation curve ➢ Regulation of Breathing ➢ Respiratory Pigments- Hemoglobin structure	09
III	➢ Blood • Composition • Function of Blood & Lymph • Blood Clotting – Factor theory • Heart beat Origin and Conduction • Heart diseases – causes, prevention and treatment. • Cardiac Cycle • E.C.G • Blood Pressure • Anemia	09
IV	➢ Excretion- • Structure of Kidney and Nephron • Mechanism of Urine Formation and Elimination ➢ Ultra filtration ➢ Selective Absorption ➢ Tubular Secretion. • Counter Current Multiplier Hypothesis • Urea Cycle	09
V	➢ Muscles- • Types • Ultra structure • Muscle Proteins ➢ Actin ➢ Myosin ➢ Tropomyosin ➢ Troponin • Physiology of Muscle Contraction – Sliding filament theory, Cori Cycle, • Muscle Properties ➢ Muscle twitch ➢ Summation ➢ Tetanus	09

	➢ Isometric and Isotonic contraction ➢ Muscle fatigue	

RECOMMENDED READINGS

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Semester-I		
MSZO 114: Ecology and Animal Behavior		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Ecological Energetics • Concept of energy • Laws governing energy transformation • Energy flow in ecosystem • Energy flow models ➢ Theories of limiting similarity • Community • Introduction • Classification • Characteristics ➢ Succession • Types • Process • Patterns • Climax concept • Models of succession	09
II	➢ Secondary Productivity ➢ Characteristics of Secondary Production in a Ecosystem ➢ Methods of estimating secondary production • Increment summation • Removal summation, • The instantaneous growth method • The Allen curve method ➢ Predation • Models of predatory dynamics • Optimal foraging theory • Patch choice • Diet choice • Prey selectivity • Foraging time ➢ Role of predation in nature- with reference to Blackbuck, chinkara, and bluebull	09
III	➢ Demography of Population • Structure and patterns of population • Life tables and its Statistical analysis ➢ Population growth • Growth of organisms with non-overlapping and overlapping population • Population growth model –Verhulst- Pearl Logistic Model	09
IV	➢ Animal behavior • Innate behavior- Types • Taxis • Kinesis • Reflexes • Fixed action pattern (Instinct) • Motivation and its different phases ➢ Learned behavior- Types • Habituation • Conditioned reflexes • Trail & error • Latent learning	09

	• Insight learning • Reasoning • Imprinting ➢ Rhythmic behaviour and Biological clocks ➢ Man- animal conflict with reference to – Blackbuck, chinkara, bluebull, Rehuseus monkey, and Leopard	
V	➢ Role of hormones in Behavior ➢ Role of pheromones in behavior ➢ Communication in animals ➢ Social behavior and organization in • Insects • Fishes • Birds • Mammals (Primates)	09

RECOMMENDED READINGS

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Semester-I

MSZO 121: Practical - Zoology Lab-I **45 Hrs**

- Dissections - *Sepia* – Nervous system, *Crab* - Nervous system, *Aplysia* – Nervous system, *Echinus*- Aristotle Lantern

- Microscopic preparation- Gemmules, Hastate plate, Statocyst T.S, Radula, L.S Ospharidium, gills, Nereis Parapodium

- Identification and Systematic position up to order of following Museum specimens-
  - Protozoa- *Paramecium*, *Noctiluca, Opalina, Balantidium, Nyctotherus, Vorticella.*
  - Porifera- *Sycon, Hyalonema, Euplectella, Euspongia*
  - Coelentrata- *Physalia, Porpita, Corallium, Gorgonia, Pennatula*.
  - Platyhelminthes- *Fasciola, Taenia, Schistosoma*
  - Aschelmenthes- *Ascaris, Dracunculus, Wucheria*.
  - Annelida- *Nereis and Hetronereis Phase, Aphrodite, Hirudinaria.*
  - Arthropoda- *Limulus, Palaemon, Apus, Lepas, Balanus, Sacculina, Schistocerca, Papilio, Bombyx, Apis, Julus, Scolopendra.*
  - Mollusca- *Chiton, Mytilus, Ostrea, Teredo, Nautilus, Octopus*
  - Echinodermata- *Pentaceros, Holothuria, Antedon*.

- Study of prepared slides- T.S *Sycon*, Ephyra Larva, Mature and Gravid Proglottid of *Taenia*, Developmental stages of *Fasciola* (Miracidium, Sporocyst, Radia, Cercaria, Metcercaria), Arthropoda Larval forms- Nauplius, Zoea, Megalopa, Mysis. Mollusca - Glochidium Larva, Echinodermata- Pedicillariae

- Physiology/ecology experiment
  - Estimation of Packed Cell Volume (P.C.V.)
  - Estimation of Hemoglobin in blood sample
  - Identification of Blood Groups
  - Estimation of Soil Moisture
  - Estimation of Water holding capacity of different soil.
  - Recording of Rainfall, Humidity and Air Pressure
  - To determine the minimum size of the quadrant by species area curve method.
  - To determine the minimum no of quadrant to be laid down in the field under study.
  - To study the community by quadrant method by determining frequency, density and abundance of different species present in community.
  - Assessing the biodiversity of a community using species diversity indices.

RECOMMENDED READINGS

- Principles Of Animal Taxonomy – G.G Simpson- Oxford & IBH Publication
- Elements Of Taxonomy – E. Mayer – Tata Mcgraw Hill Co
- Biosystematics And Taxonomy – R.C. Tripathi- University Book House
- Biodiversity, Taxonomy And Ecology – G K Singh- Alp Books
- Theory And Practices Of Animal Taxonomy- VC Kapoor – Oxford And Ibh Co
- Fundamentals Of Biodiversity And Taxonomy (HB) – J.Juneja- Cubertech Publications
- The Invertebrates- Vol I- VI –L.H Hyman – Mcgraw Hill Co
- The Invertebrate Structure And Function – E.J.W Barrington- Thomas Nelson And Sons
- Invertebrate Zoology – Rc Barnes- W.B Saunders And Co, Phillidelphia
- Text Book Of Zoology By T.J Parker And W.A Haswell- Vol I – Mcmillan And Co, London
- Biology Of Invertebrates – Pechenik – McGraw Hill Higher Education (Hb)
- General And Comparative Animal Physiology- Ws Hoar – Prientice Hall Of India
- Animal Physiology: Adaptation And Environment – Knet Schemdt Nelson – Cambridge University Press.
- Animal Physiology : Mechanism And Adaptation- R Eckert Randall- Wh Freeman And Co

- Principles Of Animal Physiology (PB) – Christopher Moyes- Pearson Education
- Text Book Of Animal Physiology By Sherwood – Cengage Learning India
- Introduction To Animal Physiology – I Kay- Garland Publishing.
- Animal Physiology By Margaret Brown- Apple Academic.
- Text Book Of Animal Physiology – R. Nagabhushnam, Kodarkar & Sarojini- Oxford IBH Co.
- Animal Behavior – Manning – Cambridge University Press.
- Ecology – Odum- W.B Saunders And Co.
- Environment And Ecology – R. Rajgopalan- Oxford India.
- Elements Of Ecology – Smith – Pearson Education.
- Animal Behavior – Dr Reena Mathur –Rastogi Publications Animal Behavior – Alcock

Semester-II		
MSZO 211: Developmental Biology		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Origin of germ cells • Spermatogenesis – ❖ Formation of spermatid ❖ Spermiogenesis ❖ Spermiation ❖ Structure of mammalian sperm • Oogenesis ❖ Formation of ova ❖ Structure of mammalian ova • Types of eggs ❖ On basis of amount of yolk ❖ On basis of distribution of yolk • Egg membranes ❖ Primary egg membranes ❖ Secondary egg membranes	09
II	➢ Fertilization • Biochemical aspect of fertilization • Penetration and activation of ova • Formation of fertilization membrane	09
III	➢ Early development – ➢ Cleavage • Characteristics • Planes and patterns ➢ Blastulation • Gastrulation • Prominent physiological features • Epiboly • Emboly • Invagination, ingression, and involution ➢ Gastrulation in amphioxus, amphibian , and Birds ➢ Fate map • Mapping techniques ➢ Early embryonic induction and differentiation	09
IV	➢ Organogenesis of following organs / organ system of mammal • Eye • Brain, • Alimentary canal, • Kidney • Gonads	09
V	➢ Assisted reproductive technologies (ART)- ➢ IVF – Procedure- • Ovarian hyper stimulation • Natural and Mild IVF • Egg retrieval • Fertilization • Embryo culture • Embryo transfer • Complications of the IVF procedure	09

	➢ ICSI – Procedure ➢ GIFT • Method • Indications • Success rate • Cloning in mammals by nucleus transfer techniques	

RECOMMENDED READINGS

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Semester-II		
MSZO 212: Microbiology		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Historical background of Microbiology: ➢ Contribution of • Antonie Von Leeuwenhoek, • Lazaro Spallanzani, • Robert Koch, • John Tyndall • Edward Jenner, • Louis Pasteur, • Alexander Fleming, ➢ Description of Protist, Prokaryotes and Eukaryotes ➢ Classification of bacteria : Bergeys manual	09
II	➢ Bacteria • Gram Positive Bacteria • Gram Negative Bacteria • Gram staining Techniques ➢ Bacterial Culture- Pure culture (Axenic culture) ➢ Culture media: • Components of media • Types of media ❖ Natural and synthetic media ❖ Chemically defined media ❖ Complex media ❖ Selective and enrichment media • Handling Method ➢ Types of Culture Techniques • Pure culture techniques; Streak plate and spread plate method • Enrichment culture technique: - Rolling tube and Candle jar method	09
III	➢ Medical Microbiology: • Pathogenecity, infection, mode of transmission of Coliform bacteria- (Escherichia coli, and Salmonella) • Causative agents, mode of transmission and control measures of diseases- Malaria and AIDS. • Microbial control: Physical, chemical and anti microbial (Antiobiotics)	09
IV	➢ Food Microbiology • Important microbes involved in spoilage of food - meat, poultry, Fish and sea food, vegetables and dairy products • Food poisoning • Food preservation- Principal and methods • Milk Microbiology ➢ Composition of milk ➢ Sources of contamination of milk and types of microbes in milk ➢ Pasteurization of milk ➢ Milk products: Cheese, butter, and yoghurt ➢ Life cycle of Yeast : Saccharomyces and its role in production of various fermented food product- bread ,wine, beer, and vinegar	09
V	➢ Role of Microbes in Environment Protection • Biodegradation-Cellulose, plastics and pesticides • Biopesticides-Introduction types (bacterial-Bacillus thruingiensis, Viral –NPV, fungal-Trichoderma)	09

	• Biofertilizers-Definition, Types (bacterial, Mycorrhizal -fungal, Plants-Azolla); kind of association, mode of application and merits. • Bioleaching – Role of microbes in metal and petroleum recovery	

RECOMMENDED READINGS

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Semester-II		
MSZO 213: Vertebrate Physiology-II		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Endocrine system – I ➢ Location, structure and function and their hormones and diseases caused by deficiency • Pineal • Hypothalamus • Pituitary • Thymus • Thyroid • Parathyroid • Pancreas	09
II	➢ Endocrine system- II ➢ Location structure and function and their hormones and diseases caused by their deficiency • Adrenal- cortex and medulla • Testis • Ovary • Mechanism of action of peptide and steroid hormones	09
III	➢ Nerve conduction- • Conduction of nerve impulse – neuronal and synaptic transmission • Neurotransmitters and their mode of action • Structure and physiology of eye • Retinal pigments • Photoreception • Photochemistry of vision	09
IV	➢ Physiology of reproduction – • Mammalian reproductive system ❖ Structure and function of Male and Female ❖ Reproductive cycles ❖ Hormonal control	09
V	➢ Osmoregulation in different animal groups. ➢ Thermoregulation ➢ Bioluminescence ➢ Chromatophore and colour change	09

RECOMMENDED READINGS

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Semester-II		
MSZO 214: Quantitative Biology		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	➢ Introduction to biostatistics: ➢ Graphical representation of data- Bar, Pie, Histogram, Frequency Polygon, frequency curve ➢ Measures of central tendency- Mean, Median and Mode in grouped and ungrouped data.	09
II	➢ Matrix: Types, Addition, Multiplication & Uses ➢ Vectors: Types, Addition & Multiplication, ➢ Data analysis: Collection, classification, Tabulation	09
III	➢ Measures of dispersion- • Range, mean deviation, standard deviation, and variance • Concept of Skewness and kurtosis • ANOVA	09
IV	➢ Probability theory – Introduction, theorem and distribution patterns ➢ Test of significance • Hypothesis testing: Null Hypothesis and alternative hypothesis, • Chi square test • Student "t" test	09
V	➢ Correlation- definition, kinds & measures ➢ Regression analysis- kinds, Regression analysis X on Y & Y on X, Regression coefficient ➢ SPSS package and Statistical Analysis Software	09

RECOMMENDED READINGS

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Semester-II

MSZO 221: Practical - Zoology Lab-II **45 Hrs**

- Physiology experiment
  - Total RBC count
  - Total WBC count
  - DLC (Differential Leucocyte Count)
  - Qualitative test for urea, creatinine and chloride in urine
  - Detection of carbohydrate, protein and lipid in milk
  - Blood sugar estimation
  - Separation of amino acid with paper chromatography & TLC
- Ecological experiments
  - Water analysis for pH, dissolved oxygen, free carbon dioxide, alkalinity/salinity and hardness.
  - Estimation of conductivity of water sample by conductivity meter
  - Identification, study and permanent preparation of zooplanktons from various water bodies
  - Estimation of productivity of water body using light and dark bottle method.
- Microbiology Experiments
  - Study of microbes in food material – fish and fish products
  - Bacteriological analysis of potable water
  - Identification of gram positive and gram negative bacteria
  - Brief idea of composition of readymade culture media
  - Preparation of bacterial broth, slants, plating and streaking
  - Preparation of bacterial growth curve of E.coli, and finding its generation time.
  - Counting of bacterial colony using colony counter.
- Biostatistics problem
  - To derive mean, median, mode
  - Derivation of standard deviation
  - To determine correlation between two data
  - Application of chi square test
  - Use of computers for analysis of variance (ANOVA)
  - Use of SPSS software package for statistical analysis

RECOMMENDED READINGS

- Developmental Biology – Scott Gilbert – PB- Palgrave Publication
- Foundations Of Embryology – Bradley M Patten And Carlson
- Human Embryology And Developmental Biology – Bruce Carlson – Mosby Publication
- Introduction To Embryology – B.I Balinsky- Thomson Nelson Publication
- Developmental Biology – Weiner A Muller- Springer Publication
- Embryology – Rajendra Kausik – Oxford Book Co
- Text Book Of Embryology - D.R. Khanna- Discovery Publishing House
- Microbiology – Jr. Michael Pelezar- Mcgraw Hill Education
- Essential Microbiology – Stuart Hogg- Pb- John Wiley And Sons
- Microbiology – An Introduction – Gerard Tortora- Pearson Education
- Food Microbiology – William Frazier, Dennis Westhoff-Pb- Tatamcgraw Hill Education
- A Text Book Of Microbiology – R. Ananthnaryan , Ck Jayaram Paniker
- Text Book Of Microbiology – Naveen Kango- Ik Publishing House
- Text Book Of Microbiology And Immunology – Sc Parija- Elsevier India
- Introduction To Food Microbiology- Kamal Duggal- Cybertech Publication
- Food Microbiology – Sk Sinha, Ashok Kumar Shrma-Hb- Oxford Book Co
- Fundamentals Of Food Microbiology – Bebek Ray, Arun Bhunia-Hb- Taylor And Francis Group
- Medical Microbiology – Michael Fraud-Pb- Oxford Univerity Press
- Essential Of Medical Microbiology- Volkwesely- Lippincott Williams And Wikins Publisher
- Microbial Taxonomy And Culture Techniques- R P Singh- Kalyani Publisher
- Introduction To Parasitology – C. Chandler And C.P Read- John Wiley And Sons

Semester-III		
MSZO 311: Chordate Biology-I		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Classification of Protochordata and Cyclostomata (up to order), Evolution and affinities of Protochordata, Life history of Pyrosoma, Doliolum, Salpa, Evolution and affinities of Cyclostomata.	09
II	Origin and Classification of Pisces, Adaptations in Fishes- Deep sea Adaptations, Offensive and Defensive Adaptations, Parental care in Fishes, Accessory Respiratory organs, Migration in Fishes. Sensory organs and lateral line System in Fishes.	09
III	Classification, Origin and Adaptive Radiations in Amphibia, Extinct Amphibia (Stegocephalia), Parental care in Amphibia, Neoteny & Paedogenesis.	09
IV	Origin and Adaptive Radiations in Reptiles, Extinct reptiles (Dinosaurs), Comparative account of Snakes and Lizards. Temporal regions of Chelonia, Crocodilia and Ophidia. Locomotion in Snakes.	09
V	Poisonous and Non Poisonous Snakes , Poison apparatus and Biting Mechanisms in Snakes, Symptoms of Snakes Bite and First Aid measures, Snakes venom, Antisera and its production.	09

RECOMMENDED READINGS

Semester-III		
MSZO 312: Vertebrate Immunology and Animal Cell Culture		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Types of Immunities - Innate, Acquired, Active, Passive. Hematopesis. Cells of Immune system and their differentiation, Organization and structure of Primary and Secondary lymphoid organs.	09
II	Antigen and Super antigen, antigenic determinates (Isotypes, Allotypes and idiotypes) , Epitope and haptens , Structure and types of various classes and sub classes of immunoglobulin, Evolution of antibody diversity.	09
III	Antigen – antibody interaction- Agglutination, RIA, ELISA and its types- "Indirect" ELISA, Sandwich ELISA, Competitive ELISA, Western blotting, MHC I and II molecules, expression and diversity, compliment system : Classical and alternate pathway, lymphocyte trafficking.	09
IV	Regulation of immune response, antigen processing and presentation, Hypersensitivity and its types, Autoimmune disorders (Autoimmunity), Immunodeficiency and AIDS, Hybriodoma technology and production of monoclonal antibodies.	09
V	Animal cell culture, equipments needed for cell culture. Culture procedure , Disintegration of tissue and primary cell culture, culture media and nutritional requirement of cell in vitro, types of culture media, evolution and maintenance of cell lines, Cryopreservation.	09

RECOMMENDED READINGS

- Text book of Zoology Vol-1I Vertebrates – Parker & Haswell (Edited by Marshall &
- Williams) (ELBS & Macmillion)
- Vertebrate life- Pough and McFerland
- Life of Vertebrates . J. Z. Yong
- Vertebrates : Comparative anatomy, function, Evolution- K. V. Kardong
- (Tata MaGraw-Hill Edition)
- Comparative Anatomy of Vertebrates- G.C. Kent & R. Carr
- The Vertebrate body- Romer & Parsons
- Biology of Vertebrates- Walter & Sayles
- Elements of Chordate Anatomy- Weichert
- Analysis of Vertebrate Structure- Hildebrand
- 2016-2017 (I & II Sem) and 2017-2018 (III & IV Sem)
- Kuby Imuunology – by R.A Goldsby, Thomas. J Kindt, Barbara A. Osborne, W.H Freeman publication
- Immunobiology by Janeway, Travers, and Walport and Shlomchick, Garland science publication
- Essential Immunology by Lan M. Roitt, etc Blackwell science publication
- Fundamentals of Immunology by William Paul, Lippinot Williams and Wilkins publication
- Understanding immunology –by A.J Cunnigham , Academia press publication
- Immunology by Benjamini
- Immunology- an introduction by Ian Tizzard, Sauders college publication
- Animal cell culture techniques by Martin Clynes
- Animal Cell Culture Volume 5 of Methods in Molecular Biology Jeffrey W. Pollard, John Marsten Walker, Humana Press, 1990
- Introduction to cell and tissue culture [electronic resource]: theory and technique by Jennie P. Mather, Penelope E. Roberts, Springer, 1998
- Animal Cell Culture: Concept and Application-Shweta Sharma, Oxford University Press 2012
- Animal Cell Culture: Concept and Application by Sheelendra Mangal Bhatt, Alpha Science International Ltd
- Animal cell culture & technology 2e, 2nd Revised Edition by M. Butler, Michael Butler, Mike Butler, CBS Pub. & Distributors Pvt. ltd.

Semester-III		
MSZO 313: Environmental Biology-I		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Ecosystem – Dynamics, Management and stability, homeostasis, niche and its overlapping. Biosphere – composition and characteristics and types - Lithosphere, hydrosphere and atmosphere.	09
II	Biosphere- Bio geochemical cycle. C, O, N, P, and S. Types of ecosystem- Terrestrial Ecosystem- characters and biota of forest, grassland, and desert. Desertification – causes creation and control, Deserts of World.	09
III	Thar Desert: Its Biota and geophysiological adaptation. Aquatic ecosystem- characteristics, and biota of Fresh water, Estuarine and marine. Ecological adaptations of animals in – cold desert, high altitude, lotic and marine environment.	09
IV	Wildlife zoogeography of India and World with reference to Amphibia, Reptiles, Birds and Mammals. Endangered & Threatened species of Amphibia, Reptiles, Birds and Mammals of India (with examples).	09
V	National parks and sanctuaries- with reference to Corbett, Ranthambore, Manas, Desert National Park, Tal Chhapar Sanctuary, Keoladev National Park. Biosphere reserves- with reference to Nanda devi, Agasthiayamalai, Dibru-Saikhowa, Nilgiri, Panchmarhi, and Sunderbans.	09

RECOMMENDED READINGS

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Semester-III		
MSZO 313: Entomology-I (Insect- Structure & Function)		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Insect morphology - Head- Structure & Different Mouth parts. Thorax- Appendages and Wings, & Wing venation, Flight Mechanism, Abdomen & its Appendages.	09
II	Structure & Function of Alimentary Canal & Associated glands, Feeding, Nutrition, Digestion and Absorption.	09
III	Excretory organs, Elimination of Nitrogenous Waste, Salt and water regulation, Detoxification.	09
IV	Tracheal system & Respiration in Terrestrial Insects. Respiration in Aquatic insects & Endoparasitic insects.	09
V	Circulatory system, Composition and function of Haemolymph, Insect immunity.	09

RECOMMENDED READINGS

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Semester-III		
MSZO 314: Environmental Biology-II / Entomology-II (Systematics, Ecology And Economic Entomology)		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Basic concept of Ecology - Holism, Ecosystem, Succession and Conservation. Ecological factors- – Climatic (light, temperature, rainfall, humidity), Topographic (altitude, direction of mountain chain and valley, steepness of slopes), Edaphic(soil complex). Biotic – positive and negative interactions.	09
II	Sustainable development – concept, strategies, principles, threats, and Commissions (national and internationals). Unsustainability – concept cause, effect.	09
III	Biodiversity: Types, Mega diversity with special reference to India. Hot spots of biodiversity of India, conservation of biodiversity.- introduction to strategies, insitu, exsitu, protected areas, biosphere reserve, restoration of endangered species, public participation.	09
IV	Natural resources- Management, monitory and conservation, watershed and wetland management, Energy crisis.	09
V	Impact of urbanization and Industrialization on environment, environmental awareness - role of Government and voluntary organization. Environment education and role of information technology, role of women in environmental awareness.	09

RECOMMENDED READINGS

- Environmental Law for the Built Environment by Jack Rostron
- Fundamental of Ecology by Odum
- Environment Protection and the Law by Dr. R K Khitoliya
- Environmental Studies by Singh, Thakur & chauhan
- Concepts of Ecology by Edward J. Kormondy
- Ecology, Environment & Pollution - P K Gupta
- Ecology and Environment by P D Sharma
- Modern Concept of Ecology by H D Kumar
- Biodiversity: Science and Development by Castri, f d & Younes
- Environment and Ecology by R. Rajgopalan – Oxford India publication
- Diversity Management: Theoretical Perspectives and Practical Approaches- Dr. Sheying Chen
- Biodiversity by E O Wilson
- Diversity of life by E O Wilson
- Threatened Animals of India- B K Tikadar
- Environmental science – A Practical manual – l.g Swarjya –PB- B.S Publication
- Practical skills in Environmental science – PB – by Allen Jones
- Water analysis – by N.K Dutta (HB) Eastern book house
- Handbook of water and waste water analysis – by Kanwaljeet Kaur (HB) –Atlantic publisher
- Manual of soil, plant & water analysis –Tahar Ali and Sumiti Naryan – Daya Publishing house
- Manual of soil, plant and water analysis – by Dhyan singh – Westville publishing house –
- Soil analysis –P.C Bandyopadhyay (HB) Daya Publishing house
- Modern methods in environmental pollution analysis- Harh Kumar – Sarup and sons
- Principles and practices of air pollution, control & analysis –J.R Mundakavi –IK P. house
- Environmental pollution analysis - S.M Khopkar – PB- New Age publication
- Handbook of methods in Environmental studies – water and waste water analysis –S.K Maiti – vol I and II – Oxford Book Company
- Standard Methods For the Examination of Water and Wastewater - Lenore S. Clesceri, Andrew D. Eaton, Eugene W. Rice , Rodger B. Baird – 22 nd Ed by American Public Health Association APHA- – Published by Alpha publishing.

Semester-III		
MSZO 314: Entomology-II (Systematics, Ecology and Economic Entomology)		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Systematics- Classification, habit, habitat and distinguishing characters of different orders of class insect (up to major families.) • Thysanura • Collembolla • Thysanoptera • Hemiptera • Lepidoptera • Isoptera	09
II	Ecology-Intraspecific & Interspecific relations, Social behavior in Hymenoptera and Isoptera, Effect of various Abiotic factors on Insect life.	09
III	Medical entomology- Morphology, Vectorship, Pathogenecity, & Control of • Anopheles, Culex, Aedes- (Mosquito) • Musca (Housefly) • Xenopsylla (Rat flea) • Pediculus – (Human louse) Veterinary entomology- Morphology, vectorship, pathogenecity, & control of • Tabanus (Horse fly) • Stomoxys (Stable fly)	09
IV	Industrial entomology - Biology Cultivation of beneficial insects - • Laccifera lacca • Bombyx mori • Apis sps	09
V	Household pests:-Morphology, damage caused & control measures - • Cockroach • Cricket • Ants & termites • Bedbugs • Silver fish • Carpet beetle	09

RECOMMENDED READINGS

- Agricultural Pests of India and South-East Asia - A. S. Atwal, Publisher- Kalyani Publishers, 1986
- Forest Entomology - William Ciesla, Publisher- John Wiley & Sons, 2011
- Useful and Destructive Insects by Matcalf & filt
- Elements of Entomology- Rajendra Singh- Rastogi Publications.
- Imms General text book of Entomology, Eds. O. W. Richards and R. G. Davis Chapman and Hall, London.
- Applied Entomology by Nigum & Kumar
- Introduction to General and Applied Entomology by V B Avasthi
- General and Applied Entomology, K.K. Nayar, T. N. Ananthkrishan and B.V. Davis, Tata McGraw -Hill Co.Ltd. Bombay.
- The Insect: Structure and function, R.F. Chapman, Cambridge University Press.
- The Physiology of Insect , Ed. M.Rockstein ,Vol, 1-5, Academic Press, New York.
- Analytical Biochemistry of Insect, Ed. R. B. Turner, Elsevier, Amsterdam.
- A Text Book of General Entomology by M.S. Mani
- Modem Entomology by Tembhare, D.B.
- How to Know The Insects. 1978 , by Roger Bland and H. E. Jaques. 3rd edition, Waveland Press, Inc.
- How to Collect and Preserve Insects: Guide Leaflet Series, No. 39 - Frank Eugene Lutz (Author) , Publisher: Literary Licensing, LLC (Aug 25 2012),

- Handbook of Entomology- M. R. Dhingra, Publisher- Oxford Book Company,
- Medical Entomology for Students - Mike Service (Author), Publisher: Cambridge University Press; 4 edition,
- Handbook of Medical Entomology- William A. Riley, Publisher- Dyson Press, 2009,
- Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods- B.F. Eldridge, J.D. Edman, Publisher- Springer, 2003,
- Handbook of Medical Entomology- O. A. 1870-1961 Johannsen, William Albert Riley, Publisher- BiblioBazaar, 2011,
- Ray, D.N. and A.W.A. Brown : Entomology Medical & Veterinary
- Bursel, E. : An Introduction to Insect Physiology
- Rockstein M. : The Physiology of Insects (Vol. 1–VI)
- Shrivastava, K.P. : A Text Book of Applied Entomology (Vol.I–H)
- Ross, H.A. : Text Book of Entomology
- Practical entomology: a guide to collecting butterflies, moths and other insects Wayside and woodland series - Richard L. E. Ford, Publisher- F. Warne, 1963,
- Forensic Entomology: The Utility of Arthropods in Legal Investigations, Second Edition, Jason H. Byrd (Editor), James L. Castner (Editor), Publisher: CRC Press; 2 edition.

Semester-III

MSZO 321: Practical - Zoology Lab-III	**45 Hrs**

- Dissection
  - Scoliodon – Efferent & Afferent System, Cranial nerves, Internal Ear, Brain & Scroll valve
  - Wallago - Cranial nerves
  - Torpedo - Electric organs
- Osteology of representative classes- Amphibia, Reptiles,
- Permanent Slides
  - Scoliodon T.S. Gill,
  - Branchiostoma- T.S. oralhood, pharynx, gonad, intestine, Caudal region.
  - Histology of various Amphibia organs- Liver, Intestine, Duodenum, Stomach, Spleen, Kidney, Ovary, Testis
- Permanent stain preparation- Placoid, Ampulla of Lorenzini
- Immunological exercise –
  - Electrophoresis
  - Radial immunodiffusion (RID)
  - Ouchterlony double diffusion (ODD)
  - ELISA
- Museum Specimens
  - Hemichordate:-Balanoglosus
  - Urochordate:- Salpa, Doliolum, Oikopleura, Herdmania
  - Cephalochordate:- Petromyzon, Myxine
  - Pisces: Zygaena, Scoliodon, Pristis, Torpedo, Trygon, Belone, Exocoetus, Anabas, Echeneis
- Microtomy- Microtomy of different organs of Rat- Liver, Lung, Kidney, Intestine, Stomach, Heart, Testis, Ovaries (Submission of 15 Microtomy Slides)

RECOMMENDED READINGS

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Semester-III	
MSZO 322: Practical - Zoology Lab-IV (Covering MSZO313A & MSZO314A)	**45 Hrs**

- Measurement of Dissolved oxygen in water ,
- Measurement of free carbon dioxide in water
- Measurement of Total Alkalinity in water
- Measurement of Sodium in water using flame photometric method.
- Measurement of Sulphide in water
- Measurement of Nitrate in water
- Measurement of phosphate in water
- Estimation of biochemical oxygen demand (BOD).
- Estimation of chemical oxygen demand (COD).
- Zooplankton identification, count, and its diversity study
- Estimation of Soil variables- EC (Electrical conductivity), Phosphate and Nitrate.

RECOMMENDED READINGS

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Semester-III	
MSZO 323: Practical - Zoology Lab-V (Covering MSZO313B & MSZO314B)	**45 Hrs**

- To study variations and different modifications of external morphology of insect
- To study variations and different modifications of Antennae, Mouth parts, Wings, Legs, genetalia & ovipositor of different insects
- Study of effect of abiotic factors on insects life
- To study different developmental stages of life cycle of mulberry silk worm (Bombyx mori) & lac insects (Laccifer lacca)
- To study different developmental stages of life cycle of stored grain pests- Oryzaephilus/ Callosobruchus/ Rhyzopertha / Sitophilus
- To study different developmental stages of life cycle of Butterfly (Daniadae / Papilionidae)
- To study the food preference of Tribolium in different food grains.
- To study different types of insects traps.
- To study haemolymph of cockroach and identification of different types of haemocytes
- Mounting:- Antennae, Mouth parts, Wings, Legs, genitalia & ovipositor of different Insects.
- Dissection of Digestive system & nervous system of-
- Gryllus
- Cockroach
- Insect's collection, preservation & identification (25 insects) of the orders Hemiptera, Lepidoptera, Isoptera.
- Identification of different insect upto families using dichotomous key.
- Preparation and submission of 20 permanent entomological slides
- Preparation of Synopsis of assigned Project Work.

RECOMMENDED READINGS

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Semester-IV		
MSZO 411: Chordate Biology-II		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Origin of birds, Affinities, Feathers in birds, Mechanism of flight in birds, Flightless birds, Palate, Aquatic birds	09
II	Types of Beaks and Claws in birds, Parental Care in Birds, Migration in birds, Economic importance of birds, connecting link- Archaeopteryx	09
III	Origin and Classification (up to sub orders) of Mammals, Prototheria, Metatheria and Eutheria, Parental care in Mammals, Aquatic Mammals, Dentition in Mammals	09
IV	Flying mammals (Chiroptera) and their adaptation, Comparative account of Old & New world Monkeys, Ancestory of Horse and Man	09
V	Wild life Sanctuaries and National Park of Rajasthan- Keoladeo (Ghana) Bird National Park, Ranthambore National Park , Wild life Conservation, Important Indian Fauna- Great Indian Bustard (Ardeotis nigriceps), Gray Langur (Semnopithecus entellus), Tiger (Panthera tigris), Common Peafowl (Pavo cristatus), Demosielle Crane (Anthropoides virgo),Wild life organizations-WWF	09

RECOMMENDED READINGS

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Semester-III		
MSZO 412: Applied Zoology – Its Tools And Techniques		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Microscopy: Principle of light transmission, Light Microscopy, Phase contrast, fluorescence microscopy, confocal electron microscopy, Golgi complex and mitochondria separation by centrifugation, Sepctrophotometry - Principle & application of UV and visible spectrophotometer.	09
II	Medical Zoology: Host- Parasite relationship. Mode of infection & pathogenicity of following pathogens with reference to main prophylaxis and treatment – Plasmodium , Giardia, Schistosoma,Wucheria, Taenia, Enterobius.	09
III	Apiculture: Species of Honey bees in India, identification of Queen, worker, drone, Types of care & maintenance of bee colonies. Bee hives, Bee Enemies , Extraction of honey and Processing, Nutritive & Medicinal values of Honey. Lac culture- cultivation, processing, enemies and uses of lac.	09
IV	Aquaculture: Fresh water fishes, Transportation of fish seed & brooders, Induced breeding, Composite fish culture, Fish Farm layout and its management, Fish products, Fresh water Prawn culture – Species, Technology and Economics, Pearl culture - Culture techniques.	09
V	Population dynamics of Insect Pests, Principles of biological, chemical, mechanicals, Cultural control of pest, Integrated Pest Management.	09

RECOMMENDED READINGS

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Semester-III		
MSZO 413: Environmental Biology-I		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Population Ecology – Definition, Density, Mortality, Natality, population fluctuation, dispersal, equilibrium, age pyramid, distribution, growth curve. Factors affecting population growth and regulation.	09
II	Environmental Pollution – Air pollution – Types of pollutants, secondary air pollution, effect and control. Water pollution – Types of pollutants, sources, effects and control. Noise pollution – Source, properties, measurements of noise, effect & control.	09
III	Environmental Pollution - Soil pollution- sources, effects and control, Radiation Pollution – Types of radiation, nuclear fallouts, effect of radiation on ecosystem, Nuclear accident. Thermal Pollution – Source, effect and control.	09
IV	Impact of environmental pollution – Global warming, Acid rain, Green house effect, Ozone layer depletion, Solid Waste – Disposal & Management.	09
V	Ecotoxicology – Introduction, types of ecotoxicants, Dose –Response Relationship. Toxic effects and impact from individual to ecosystem.	09

RECOMMENDED READINGS

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Semester-III		
MSZO 413: Entomology-I (Insects- Function and Development)		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Nervous System – Basic Components, Basic Function Anatomy, Brain, Transmission of nerve, impulse in insects.	09
II	Endocrine System – Endocrine organs, Hormones and Pheromones, Endocrine control of Polymorphism in Insects.	09
III	Perception of the Environment:- • Eyes - Compound eyes, functioning of eyes other visual receptors. • Sound producing organs. • Light producing organs. • Thermoregulation.	09
IV	Reproduction in Insects. • Reproduction System male. • Reproduction System female • Insects Embryology – Egg and its development upto formation of extra embryonic membranes, viviparity, Polyembryony, Parthenogenesis and Paedogenesis.	09
V	Post embryonic Development:- • Hatching • Metamorphosis ❖ Larval development and types of larvae ❖ Pupal development and types of pupae • Control of post embryonic development • Diapause.	09

RECOMMENDED READINGS

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Semester-III		
MSZO 414: Environmental Biology-II		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Bioaccumulation, Biomagnifications – Biological transfer of bioaccumulation in ecosystem. Bioremediation – Need, merits, scope and current status. Biodegradation – plastic and pesticides.	09
II	Health Hazards – Pesticides, Heavy metals, Dyes, Detergents and Fertilizers. Monitoring and remedial measures to control these pollutants.	09
III	Environment Impact Assessment (EIA) – Concept, objectives, components, methodology, Environment Appraisal committees. Benefits of EIA Process.	09
IV	Remote Sensing – Introduction, physical basis for remote sensing, process, specified remote sensing satellites , system for data collection. Application & advantages of remote sensing.	09
V	Environmental policy in India, problems in making & implementing the Environmental laws, Indian Environmental Acts – Duties of State & Central Board, Wild life protection Act 1972, Biodiversity Act 2002, Environment protection Act1986, National Environment Tribunal Act 1995, Air (Prevention and Control of Pollution) Act 1981, Water (Prevention and Control of Pollution) Act 1974.	09

RECOMMENDED READINGS

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Semester-III		
MSZO 414: Entomology-II (Systematics, Agriculture Entomology and Pest Management)		**45 Hrs**
इकाई Unit	**पाठ्यक्रम सामग्री Course Content**	**Hours/ Unit**
I	Systematics Classification, habit, habitat and distinguishing characters of different order of class Insecta classification up to major families. • Odonata • Orthoptera • Diptera • Hymenoptera • Coleopter	09
II	Agriculture entomology - I Systematic position, morphology, Damage and Control Measures of – • Pests of Vegetables & Fruits ❖ Dacus cucurbitae (Melon fly) ❖ Papilio demoleus (Lemon butterfly) • Pests of Sugarcane ❖ Pyrilla perpusilla (Sugarcane leaf hopper) ❖ Scirpophaga novella (Sugarcane top borer) • Pests of pulses and oilseeds ❖ Helicoverpa armigera (Cotton boll worm) ❖ Lipaphis erysimi (Mustard Aphid) • Polyphagus Pests ❖ Schistocerca gregaria (Desert Locust) ❖ Locusta migratoria (Migratory Locust)	09
III	Agriculture entomology - II • Pests of cereals	09

	❖ Mythimna seperata (Northern armyworm) ❖ Sitobion avenae (Wheat Aphid) • Pests of fiber crop ❖ Pectinophora gossypiella (Pink boll worm) ❖ Dysdercus koenigii (Cotton stainer) • Pests of paddy ❖ Dicladispa armigera (Spiny Leaf Beetle) ❖ Spodoptera sps (African army worm) • Pests of stored grains ❖ Rhyzopertha dominica (Lesser Grain Borer) ❖ Tribolium sps (Red Flour Beetles)	
IV	Forensic entomology • Introduction • Insects of forensic importance • Entomological evidence collection during death investigations • Forensic entomological decomposition • Preliminary Idea about Post Mortem Interval (PMI) • Preliminary idea about some forensic important insects- Flies & Beetles	09
V	Pests management • Concept of Pests. • Physical, Mechanical, Cultural & Biological Control. • Modern methods of Control. • Integrated pest management (IPM) • Brief idea about Control of Bees and Wasps	09

RECOMMENDED READINGS

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Semester-III

MSZO 421: Practical - Zoology Lab-VI **45 Hrs**

- Dissection
  - Labeo / Cirrhinus mrigala - cranial nerve and & Webarian organs
  - Clarias, Ophiocephalus, Anabas, Heteropneustes (Saccobranchus) -Accessory Respiratory organs & Webarian organs.
- Osteology of representative classes- Aves and Mammals.
- Permanent Slides
  - Histology of various Mammal organs- Liver, Intestine, Duodenum, Stomach, Spleen, Kidney, Ovary, Testis.
  - Reptiles- V.S. skin
  - Aves- Various types of Feathers
  - Chick embryology – 18, 24, 33, 48, 72 hours
- Permanent stain preparation- Cycloid and Ctenoid Scales, Sting of Honey bee, Ticks and mites, Aphids, Pediculus.
- Museum Specimens
  - Amphibia: Necturus, Amphiuma, Ambystoma, Axolotal Larva,
  - Reptiles : Ophiosaurus, Naja, Bungarus, Echis, Hydrophis, Eryx, Python, Crocodilus, Gavialis
  - Aves: Columba, Pavo, Choriotis
  - Mammals: Funambulus, Rattus, Suncus, Maccaca. Semnopithecus (Gray Langur)
- To study diversity of beaks in birds
- To study diversity of feet in birds
- Report on Public awareness about environmental issues/ visit to scientific organizations/institutes.

RECOMMENDED READINGS

- Text book of Zoology Vol-1I Vertebrates – Parker & Haswell (Edited by Marshall & Williams) (ELBS & Macmillion)
- Vertebrate life- Pough and McFerland
- Life of Vertebrates. J. Z. Young
- Vertebrates : Comparative anatomy, function, Evolution- K. V. Kardong (Tata MaGraw-Hill Edition)
- Comparative Anatomy of Vertebrates- G.C. Kent & R. Carr
- The Vertebrate body- Romer & Parsons
- Biology of Vertebrates- Walter & Sayles
- Elements of Chordate Anatomy- Weichert
- Analysis of Vertebrate Structure- Hildebrand
- Fish and Fisheries- Shukla, Pandey
- Applied Entomology- P. G. Fenemore, A Prakash
- Freshwater Aquaculture- Santhanam et al.
- Sericulture & Silk Industry- D. C. Sarkar
- Economic Zoology- Shukla Upadhyay
- Elements of Entomology- Rajendra Singh
- Insect Pest of crop- S. Pradhan
- Applied zoology- Ansari, Varma, Sharma
- Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods- B.F. Eldridge, J.D. Edman, Publisher- Springer, 2003,
- Handbook of Medical Entomology- O. A. 1870-1961 Johannsen, William Albert Riley, Publisher- BiblioBazaar, 2011

Semester-III

MSZO 422: Practical - Zoology Lab-VII	**45 Hrs**

- Biomass and population density of terrestrial group, sampling and statistical analysis.
- Measurement of potassium in water using flame photometric method.
- Measurement of magnesium in water
- Measurement of Chloride in water
- Measurement of Silicate in water
- Estimation of tannin in polluted water
- Estimation of water quality index
- Assessing the noise pollution level.
- Assessing the respirable particulate matter (PM10)/ fine particulate matter (PM2.5) in ambient air
- Assessing the gaseous pollutants (SO2, NO2), and ozone in ambient air.
- Study of microbes in polluted and fresh water
- Identification and study of different migratory birds of this region
- Visit to environmental important site.
- Project Report.

RECOMMENDED READINGS

- Environmental Law for the Built Environment by Jack Rostron
- Fundamental of Ecology by Odum
- Environment Protection and the Law by Dr. R K Khitoliya
- Environmental Studies by Singh, Thakur & chauhan
- Concepts of Ecology by Edward J. Kormondy
- Ecology, Environment & Pollution by P K Gupta
- Ecology and Environment by P D Sharma
- Modern Concept of Ecology by H D Kumar
- Threatened Animals of India by B K Tikadar
- Environmental science – A Practical manual – l.g Swarjya –PB- B.S Publication
- Practical skills in Environmental science – PB – by Allen Jones
- Water analysis – by N.K Dutta (HB) Eastern book house
- Handbook of water and waste water analysis – by Kanwaljeet Kaur (HB) –Atlantic publisher
- Manual of soil, plant and water analysis – by Tahar Ali and Sumiti Naryan – Daya Publishing house
- Manual of soil, plant and water analysis – by Dhyan singh – Westville publishing house –
- Soil analysis – by P.C Bandyopadhyay (HB) Daya Publishing house
- Modern methods in environmental pollution analysis- Harh Kumar – Sarup and sons
- Principles and practices of air pollution , control and analysis – byJ.R Mundakavi –IK publishing house
- Environmental pollution analysis – by- S.M Khopkar – PB- New Age publication
- Handbook of methods in Environmental studies – water and waste water analysis – byS.K Maiti – vol I and II – Oxford Book Company
- Standard Methods For the Examination of Water and Wastewater (Hardcover) by Lenore S. Clesceri, Andrew D. Eaton, Eugene W. Rice , Rodger B. Baird (HB) – 22 nd Ed by American Public Health Association APHA- – Published by Alpha publishing.

Semester-III

MSZO 423: Practical - Zoology Lab-VIII **45 Hrs**

- Culture of Drosophila and study of its different developmental stages of life cycle.
- To isolate and mount salivary glands of Drosophila.
- To identify male and female individual from the given Grasshopper set.
- To study artificial bee hive structure and its different parts.
- To study different plant protecting equipments. (Spraying & Dusting)
- Method of formulation and dilution of different insecticides.
- Study of different castes of honey bee and termite.
- To study structure of termitarium / Bee Hive/ Wasp Hive
- Mounting: sting apparatus of Honey bee/ Wasp
- To identify and locate tympanum of Grasshopper
- Dissection: Digestive and Nervous System of
  - Grasshopper
  - Honey bee
  - Wasp
- Insect Collection, preservation and identification of insects. 25 different insects of - Odonata, Orthoptera, Diptera, Hymenoptera, Coleoptera.
- Identification of different order of insects up to families by using dichotomous keys.
- Preparation and submission of 20 permanent entomological slides
- Project Report/ Presentation.

RECOMMENDED READINGS

- Modern Entomology (Second edition): D. B. Tembhare, Himalaya Publication House, Bombay.
- Destruction and Useful Insect, Their Hanits and Control, C. L. Metcalf, W. P. Flint and R. I. Metcalf, Mc Grow I Ill Co. New York.
- Text Book of Entomology, K. P. Shivastava, Vol. 1 And 2 Kalyani Publication, Ludhiana.
- Agriculture Entomology, H. S. Dennis, Timber Press Inc.
- A Text Book of Agricultural Entomology ESSIG : College Entomology by Hemsingh Pruthi
- Entomology: At a Glance Volume 2 Objective Fundamentals- R.C. Saxena, Agrotech Publishing,
- The Science of Entomology. William S. Romoser and John G. Stoffolano, Jr. Fourth edition. WBC/McGraw-Hill, Boston, MA 1998
- Oldoyd, N. : A Collection, Preserving and Studying Insects
- Roger P. and Anderson : Forest and Shade Tree Entomology
- Fradt, R.E. : Fundamentals of Applied Entomology
- Smith, K.G.V. : Insects and Other Arthropods of Medical Importance
- Berryman, A. (1986) Forest Insects: Principles and Practice of Population Management. Plenum Press, New York.
- Coulson, R.N. and Witter, J.A. (1984) Forest Entomology: Ecology and Management. John Wiley & Sons, Inc., New York.
- Applied Entomology: ICAR JRF ARS SAUs Entrance Exams UPSC Civil Services Prelims 2nd ed , Author: D S Reddy