MSC ZOOLOGY I SEMESTER

CODE	DESCRIPTION	PD/W	EXAM	CIA	ESE	TOTAL
MSZO 111	BIOSYSTEMATICS & EVOLUTION	4	3hrs	30	70	100
MSZO112	STRUCTURE & FUNCTION OF INVERTEBRATES	4	3hrs	30	70	100
MSZO 113	VERTEBRATE PHYSIOLOGY I	4	3hrs	30	70	100
MSZO114	ECOLOGY AND ANIMAL BEHAVIOR	4	3hrs	30	70	100
MSZO121	PRACTICAL BOARD I PRACTICAL BOARD II	24	5 hrs 5 hrs	30 30	70 70	100 100
TOTAL				180	420	600

MSZO 111: BIOSYSTEMATICS & EVOLUTION	
UNIT - 1	• Biosystematics o Definition o Importance of Biosystematics o Applications of Biosystematics in Biology • Neotaxonomy – Consequences of New Systematics o Chemotaxonomy - ▪ Kinds ▪ Immunological Approach ▪ Chromatographic Approach ▪ Histo-chemical Approach • Cytotaxonomy – o Chromosomal behaviour ▪ Karyotype test ▪ Chromosome number ▪ Chromosome morphology o Banding pattern – G,C,R,Q Banding • Molecular Taxonomy o Source of variation, satellite DNA (Mini and micro DNA) o Ribotyping and DNA sequencing
UNIT - 2	• Taxonomic Procedure - o Collection - ▪ Value of Collection ▪ Purpose of Scientific Collection ▪ Collecting & Research ▪ Scope of Collection ▪ Where & How to Collect ▪ Content of Collection o Preservation - ▪ Introduction ▪ Process of Preservation ▪ Preservation of invertebrates and vertebrates (Basic Idea) o Curating - ▪ Preparation of Material for Study ▪ Housing ▪ Cataloging ▪ Arrangement of Collection ▪ Curating of types ▪ Exchange of Material ▪ Expendable Material • Taxonomic Keys - Types o Indented Key o Bracket Key

	○ Ground Types ○ Pictorial Type ○ Branching Type ○ Circular Type ○ Box Type
UNIT - 3	• 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
UNIT - 4	• 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 • Evolution of Man – ○ Pre human ancestors

	• Evolution of man in Pleistocene
UNIT - 5	• Variation – o Kinds of Variation- • Meristic & substantive • Continuous & Discontinuous • Determinate & Indeterminate • Somatic & Germinal o Sources of Variation o Basis of Variation – • Chromosomal Aberration • Variations in chromosome number • Natural Selection – o Types – • Stabilizing selection • Directional Selection • Disruptive Selection • Genetic Drift – • Theory of genetic Drift • Salient Features of Genetic Drift • Genetic basis of Random Genetic Drift • Hardy-Weinberg equilibrium & Genetic Drift • Mimicry – o Kinds – ▪ Protective ▪ Aggressive ▪ Conscious o Significance of Mimicry

MSZO 112: STRUCTURE & FUNCTION OF INVERTEBRATES	
UNIT - 1	• Organization of Coelom o Evolution of Coelom (Various Theories) o Modification of Coelom o Significance of Coelom • Acoelomate • Pseudocoelomate • True Coelomate • Metamerism – Types, Origin and Evolution • Difference between Protostomia and Deuterostomia
UNIT - 2	▪ Nutrition, Feeding, Structure and physiology of Digestion o Protozoa o Platyhelminthes (Class Turbillaria) o Annelida (Class Polychaeta) o Arthropoda (Class Insecta) o Mollusca (Class Cephalopoda) o Echinodermata
UNIT - 3	▪ Different types of Respiratory organs in Invertebrates- their structure and functions o Gills o Lungs o Trachea • Respiratory Pigments (Specific to invertebrates only)
UNIT - 4	▪ Different types of Excretory organs in Invertebrates- their structure and functions o Nephridia o Malphigian Tubules

	Brief idea about accessory excretory organs ○ Coaxial Glands ○ Kebers Organ ○ Bojanus Organ
UNIT - 5	• Nervous System ▪ Primitive Nervous System – Echinodermata ▪ Advanced Nervous System – ○ Annelida (Class Oligochaeta) ○ Arthropoda (Class Insecta) ○ Mollusca (Class Cephalopoda)

MSZO 113: VERTEBRATE PHYSIOLOGY I	
UNIT - 1	▪ 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
UNIT - 2	▪ 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
UNIT - 3	▪ 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
UNIT - 4	▪ Excretion- ○ Structure of Kidney and Nephron ○ Mechanism of Urine Formation and Elimination- • Ultra filtration • Selective Absorption • Tubular Secretion. ○ Counter Current Multiplier Hypothesis ○ Urea Cycle. ○ ***Stone formation in kidney and gall bladder- causes, prevention and treatment***
UNIT - 5	• Muscles- ○ Types ○ Ultra structure ○ Muscle Proteins-

	• Actin • Myosin • Tropomyosin • Troponin o Physiology of Muscle Contraction – Sliding filament theory, Cori Cycle, o Muscle Properties- • Muscle twitch • Summation • Tetanus • Isometric and Isotonic contraction • Muscle fatigue

MSZO 114: ECOLOGY AND ANIMAL BEHAVIOR	
UNIT - 1	• Ecological Energetics o Concept of energy o Laws governing energy transformation o Energy flow in ecosystem o Energy flow models- **Lineman model, Odum model (Y shape model)** • Theories of limiting similarity • Community o Introduction o Classification o Characteristics • Succession o Types o Process o Patterns o Climax concept o Models of succession
UNIT - 2	• Secondary Productivity • Characteristics of Secondary Production in a Ecosystem • Methods of estimating secondary production o Increment summation o Removal summation, o The instantaneous growth method o The Allen curve method • Predation o Models of predatory dynamics o Optimal foraging theory • Patch choice • Diet choice • Prey selectivity • Foraging time • Role of predation in nature- ***with reference to Blackbuck, chinkara, and bluebull***
UNIT - 3	• Demography of Population o Structure and patterns of population o Life tables and its Statistical analysis • Population growth o Growth of organisms with non-overlapping and overlapping population o Population growth model –Verhulst- Pearl Logistic Model
UNIT - 4	Animal behavior • Innate behavior- Types o Taxis

	○ Kinesis ○ Reflexes ○ Fixed action pattern (Instinct) ○ Motivation and its different phases • Learned behavior- Types ○ Habituation ○ Conditioned reflexes ○ Trial & error ○ Latent learning ○ Insight learning ○ Reasoning ○ Imprinting • Rhythmic behaviour and Biological clocks • ***Man- animal conflict with reference to – Blackbuck, chinkara, bluebull ,Rehuseus monkey, and Leopard***
UNIT - 5	• Role of hormones in Behavior • Role of pheromones in behavior • Communication in animals - **types** • Social behavior and organization in ○ Insects – **Hymenoptera and Isoptera,** ○ Fishes – **cat fishes** ○ Birds – **migratory birds** ○ Mammals (Primates)- **Presbytes**

MSZO 121: PRACTICAL BOARD I
A. Dissections - *Sepia* – Nervous system, **Palaemon - Nervous system**, *Aplysia* – Nervous system, *Echinus*- Aristotle Lantern B. Microscopic preparation- Gemmules, Hastate plate, Statocyst *Nereis* Parapodium C. 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*, **Life history of *Laccifer lacca*** Mollusca- *Chiton, Mytilus, Ostrea, Teredo, Nautilus, Octopus* Echinodermata- *Pentaceros, Holothuria, Antedon*. D. 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

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED	TIME DURATION
1.	Dissection	20	5 HRS
2.	Microscopic Preparation	10	5 HRS
3.	Spots (6 x 4)	30	5 HRS
4.	CCA	30	5 HRS
5.	Viva Voice	10	5 HRS
	TOTAL	100	

MSZO 121: PRACTICAL BOARD II
E. Physiology Experiments

1. Estimation of Packed Cell Volume (P.C.V.)
2. Estimation of Hemoglobin in blood sample
3. Identification of Blood Groups **and Rh factor**
4. Study of E.C.G. of different age group persons and its analysis.
5. Blood smear and identification of different types of blood cells.
6. Demonstration of working of sphygmomanometer (B.P. measurement) with the help of stethoscope.

F Ecological experiments

1. To study soil texture colour and appearance.
2. Estimation of Soil Moisture **content**
3. Estimation of Water holding capacity of different soil.
4. Recording of Rainfall, Humidity and Air Pressure
5. To study the community by quadrant method by determining frequency, density and abundance of different species present in community.
6. Assessing the biodiversity of a community using species diversity indices.
7. Water analysis for pH, dissolved oxygen, free carbon dioxide, alkalinity/salinity and hardness.
8. Estimation of conductivity of water sample by conductivity meter
9. Identification, study and permanent preparation of zooplanktons from various water bodies
10. Estimation of productivity of water body using light and dark bottle method

G. Animal behavior experiments

1. To study the response of light to store grain pest
2. To study prey and predator relationship
3. To study effect of trail pheromone in ants communication.
4. To study nesting behavior of birds/wasps

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED	TIME DURATION
1.	Physiology Experiments	20	5 HRS
2.	Ecological experiments	20	5 HRS
3.	Animal ethology experiment	20	5 HRS
4.	CCA	30	5 HRS
5.	Viva Voice	10	5 HRS
	TOTAL	100	

SUGGESTED READINGS

1. Principles Of Animal Taxonomy – G.G Simpson- Oxford & IBH Publication
2. Elements Of Taxonomy – E. Mayer – Tata Mcgraw Hill Co
3. Biosystematics And Taxonomy – R.C. Tripathi- University Book House
4. Biodiversity, Taxonomy And Ecology – G K Singh- Alp Books
5. Theory And Practices Of Animal Taxonomy- VC Kapoor – Oxford And Ibh Co
6. Fundamentals Of Biodiversity And Taxonomy (HB) – J.Juneja- Cubertech Publications
7. The Invertebrates- Vol I- VI –L.H Hyman – Mcgraw Hill Co
8. The Invertebrate Structure And Function – E.J.W Barrington- Thomas Nelson And Sons
9. Invertebrate Zoology – Rc Barnes- W.B Saunders And Co, Phillidelphia
10. Text Book Of Zoology By T.J Parker And W.A Haswell- Vol I – Mcmillan And Co, London
11. Biology Of Invertebrates – Pechenik – McGraw Hill Higher Education (Hb)
12. General And Comparative Animal Physiology- Ws Hoar – Prientice Hall Of India
13. Animal Physiology: Adaptation And Environment – Knet Schemdt Nelson – Cambridge University Press
14. Animal Physiology : Mechanism And Adaptation- R Eckert Randall- Wh Freeman And Co
15. Principles Of Animal Physiology (PB) – Christopher Moyes- Pearson Education
16. Text Book Of Animal Physiology By Sherwood – Cengage Learning India
17. Introduction To Animal Physiology – I Kay- Garland Publishing
18. Animal Physiology By Margaret Brown- Apple Academic
19. Text Book Of Animal Physiology – R. Nagabhushnam, Kodarkar & Sarojini- Oxford IBH Co

20. Animal Behavior – Manning – Cambridge University Press
21. Ecology – Odum- W.B Saunders And Co
22. Environment And Ecology – R. Rajgopalan- Oxford India
23. Elements Of Ecology – Smith – Pearson Education
24. Animal Behavior – Dr Reena Mathur –Rastogi Publications Animal Behavior – Alcock
25. A Text Book Of Animal Behavior – F.B.Manda- Phi Publication
26. Animal Behavior – H.V. Bhaskar – Campus Book International
27. Animal Behavior – V.K Agarwal – S. Chand And Co , India
28. Fundamentals Of Animal Behavior – A Sarkar –Discovery Publishing House

MSC ZOOLOGY II SEMESTER

CODE	DESCRIPTION	PD/W	EXAM	CIA	ESE	TOTAL
MSZO 211	DEVELOPMENTAL BIOLOGY	4	3hrs	30	70	100
MSZO212	MICROBIOLOGY	4	3hrs	30	70	100
MSZO 213	VERTEBRATE PHYSIOLOGY II	4	3hrs	30	70	100
MSZO214	QUANTITATIVE BIOLOGY	4	3hrs	30	70	100
MSZO221	PRACTICAL BOARD I PRACTICAL BOARD II	24	5 hrs 5 hrs	30 30	70 70	100 100
TOTAL				180	420	600

MSZO 211: DEVELOPMENTAL BIOLOGY	
UNIT - 1	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
UNIT - 2	Fertilization: • Biochemical aspect of fertilization • Penetration and activation of ova, • Formation of fertilization membrane,
UNIT - 3	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
UNIT - 4	Organogenesis of following organs / organ system of mammal • Eye • Brain, • Alimentary canal, • Kidney • Gonad
UNIT - 5	• Assisted reproductive technologies (ART)-

	• IVF (In Vitro Fertilization) – Procedure- ○ Ovarian hyper stimulation ○ Natural and Mild IVF ○ Egg retrieval ○ Fertilization ○ Embryo culture ○ Embryo transfer ○ Complications of the IVF procedure • ICSI(intra-cytoplasmic sperm injection) - Procedure • GIFT (Gamete intra-fallopian transfer) • Method • Indications • Success rate • Cloning in mammals by nucleus transfer techniques

MSZO 212: MICROBIOLOGY	
UNIT - 1	• Historical background of Microbiology: • Contribution of a) Antonie Von Leeuwenhoek, b) Lazaro Spallanzani, c) Robert Koch, d) John Tyndall e) Edward Jenner, f) Louis Pasteur, g) Alexander Fleming, • Description of Protist, Prokaryotes and Eukaryotes • Classification of bacteria : Bergeys manual
UNIT - 2	• Bacteria 1. Gram Positive Bacteria 2. Gram Negative Bacteria 3. Gram staining Techniques • Bacterial Culture- Pure culture (Axenic culture) • Culture media: A. Components of media B. Types of media 1. Natural and synthetic media 2. Chemically defined media 3. Complex media 4. Selective and enrichment media C. Handling Method • Types of Culture Techniques : 2. Pure culture techniques; Streak plate and spread plate method 3. Enrichment culture technique: - Rolling tube and Candle jar method
UNIT - 3	Medical Microbiology: • Pathogenecity, infection, mode of transmission of Coliform bacteria- (*Escherichia coli*, and *Salmonella*) **Basic idea about Probiotics** • Causative agents, mode of transmission and control measures of diseases- Malaria and AIDS. • Microbial control: Physical, chemical and anti microbial (Antiobiotics)
UNIT - 4	• Food Microbiology 1. Important microbes involved in spoilage of food - meat, poultry, Fish and sea food, vegetables and dairy products , 2. Food poisoning 3. Food preservation- Principal and methods 4. 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 5. Life cycle of Yeast : *Saccharomyces* and its role in production of various fermented food product- bread ,wine, beer, and vinegar
UNIT - 5	Environmental Microbiology: • Role of Microbes in Environment Protection o Biodegradation- plastics and pesticides o Biopesticides -Introduction types (bacterial-*Bacillus thruingiensis*, Viral –NPV, fungal-*Trichoderma*) o Biofertilizers-Definition, Types (bacterial, Mycorrhizal -fungal, Plants-*Azolla*); kind of association, mode of application and merits. o Bioleaching – Role of microbes in metal and petroleum recovery

MSZO 213: VERTEBRATE PHYSIOLOGY II	
UNIT - 1	Endocrine system – I Location, structure and function and their hormones and diseases caused by deficiency • Pineal • Hypothalamus • Pituitary, • Thymus, • Thyroid, • Parathyroid, • Pancreas
UNIT - 2	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.
UNIT - 3	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
UNIT - 4	Physiology of reproduction – • Mammalian reproductive system o Structure and function of Male and Female o Reproductive cycles o Hormonal control
UNIT - 5	• Osmoregulation in different animal groups. • Thermoregulation • Bioluminescence • Chromatophore and colour change

MSZO 214: QUANTITATIVE BIOLOGY

UNIT - 1	1. Introduction to biostatistics: 2. Graphical representation of data- Bar, Pie, Histogram, Frequency Polygon, frequency curve 3. Measures of central tendency- Mean, Median and Mode in grouped and ungrouped data
UNIT - 2	• Matrix: Types, Addition, Multiplication & Uses • Vectors: Types, Addition & Multiplication, • Data analysis: Collection, classification, Tabulation
UNIT - 3	Measures of dispersion- 1. Range, mean deviation, standard deviation, and variance 2. Concept of Skewness and kurtosis 3. ANOVA.
UNIT - 4	Probability theory – Introduction, theorem and distribution patterns Test of significance 1. Hypothesis testing: Null Hypothesis and alternative hypothesis, 2. Chi square test, 3. Student "t" test
UNIT - 5	• Correlation- definition, kinds & measures • Regression analysis- kinds, Regression analysis X on Y & Y on X, Regression coefficient • SPSS package and Statistical Analysis Software

MSZO 221: PRACTICAL BOARD I
A. Microbiology Experiments 1. Study of microbes in food material – fish and fish products 2. Bacteriological analysis of potable water 3. Identification of gram positive and gram negative bacteria 4. Brief idea of composition of readymade culture media 5. Preparation of bacterial broth, slants, plating and streaking **6.** Preparation of bacterial growth curve of *E.coli,* ***and finding its generation time.*** ***7. Counting of bacterial colony using colony counter.*** B. Chromatography 1. Separation of amino acid with paper chromatography 2. Separation of amino acid with TLC **(**Thin-layer chromatography) C. Biochemistry experiments 1. Qualitative test for urea, creatinine and chloride in urine 2. Detection of carbohydrate, protein and lipid in milk 3. Biochemical test on enzymes. D. Developmental biology slides- 1. structure of ovum, blastula stage, gastrula, tadpole larva whole mount 2. Chick embryology- 18,24,33,48, and 72 hrs stage of incubation. 3. Spermatogenesis and oogenesis in mammals 4. ART techniques

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED	TIME DURATION
1.	Microbiology experiment	20	5 HRS
2.	Chromatography experiment	08	5 HRS
3.	Biochemistry	20	5 HRS
4.	Spots (4 x 3)	12	5 HRS
5.	CCA	30	5 HRS
5.	Viva Voice	10	5 HRS
	TOTAL	100	

MSZO 221: PRACTICAL BOARD II
A. Physiology experiment

1. Total RBC count
2. Total WBC count
3. DLC (Differential Leukocyte Count)
4. Blood sugar estimation

B. Biostatistics problem

1. To derive mean, median, mode
2. Derivation of standard deviation
3. To determine correlation between two data
4. Application of chi square test
5. Use of computers for analysis of variance (ANOVA)
6. Use of SPSS software package for statistical analysis
7. Biostatistics PROBLEM
8. Biostatistics PROBLEM

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED	TIME DURATION
1.	Physiology experiment	20	5 HRS
2.	Biostatistics problem	20	5 HRS
3.	CCA	30	5 HRS
4.	Viva Voice	10	5 HRS
5.	Local Visit	20	5 HRS
	TOTAL	100	

SUGGESTED READINGS

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

MSC ZOOLOGY III SEMESTER

CODE	DESCRIPTION	PD/ W	EXAM	CIA	ESE	TOTAL
MSZO 311	CHORDATE BIOLOGY I	6	3hrs	30	70	100
MSZO312	VERTEBRATE IMMUNOLOGY AND ANIMAL CELL CULTURE	6	3hrs	30	70	100
MSZO 313A / MSZO 313B	ENVIRONMENTAL BIOLOGY I / ENTOMOLOGY-I (INSECT- STRUCTURE & FUNCTION)	3/3	3hrs	30	70	100
MSZO314A/ MSZO 314B	ENVIRONMENTAL BIOLOGY II /ENTOMOLOGY-II (SYSTEMATICS, ECOLOGY AND ECONOMIC ENTOMOLOGY)	3/3	3hrs	30	70	100
MSZO321	PRACTICAL	12	6 hrs	30	70	100
MSZO322A	PRACTICAL	12	6 hrs	30	70	100
MSZO322B	PRACTICAL	12	6 hrs	30	70	100
TOTAL				180	420	600

MSZO 311: CHORDATE BIOLOGY I	
UNIT - 1	Classification of Protochordata and Cyclostomata (up to order), Evolution and affinities of Protochordata, Life history of *Pyrosoma, Doliolum, Salpa*, Evolution and affinities of Cyclostomata.
UNIT - 2	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
UNIT - 3	Classification, Origin and Adaptive Radiations in Amphibia, Extinct Amphibia (Stegocephalia), Parental care in Amphibia, Neoteny & Paedogenesis
UNIT - 4	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
UNIT - 5	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.

MSZO 312:	
UNIT - 1	Types of Immunities - Innate, Acquired, Active, Passive. Hematopoesis. Cells of Immune system and their differentiation, Organization and structure of Primary and Secondary lymphoid organs
UNIT - 2	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
UNIT - 3	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
UNIT - 4	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
UNIT - 5	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.

MSZO 321: PRACTICALS
A. Dissection 1. *Scoliodon* – Efferent & Afferent System, Cranial nerves, Internal Ear, Brain & Scroll valve 2. *Wallago* - Cranial nerves 3. *Torpedo* - Electric organs B. Osteology of representative classes- Amphibia, Reptiles, C. Permanent Slides 1. *Scoliodon* T.S. Gill, 2. *Branchiostoma*- T.S. oralhood, pharynx, gonad, intestine, Caudal region.

3. Histology of various Amphibia organs- Liver, Intestine, Duodenum, Stomach, Spleen, Kidney, Ovary, Testis

D Permanent stain preparation- Placoid, Ampulla of Lorenzini

E. ***Immunological exercise –***

1. ***Electrophoresis***
2. ***Radial immunodiffusion (RID)***
3. ***Ouchterlony double diffusion (ODD)***
4. ***ELISA***

F. Museum Specimens

1. Hemichordate:-*Balanoglosus*
2. Urochordate:- *Salpa, Doliolum, Oikopleura, Herdmania*
3. Cephalochordate:- *Petromyzon, Myxine*
4. Pisces: *Zygaena, Scoliodon, Pristis, Torpedo, Trygon, Belone, Exocoetus, Anabas, Echeneis*
5. G. Microtomy- Microtomy of different organs of Rat- Liver, Lung, Kidney, Intestine, Stomach, Heart, Testis, Ovaries (Submission of 15 Microtomy Slides)

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED	TIME DURATION
1.	Dissection	20	6 HRS
2.	Spots (5 x 3)	12	6 HRS
3.	Immunological exercise	10	6 HRS
4.	CCA	30	6 HRS
5.	Microtomy	15	6 HRS
6.	Viva Voice	10	6 HRS
	TOTAL	100	

SUGGESTED READINGS (COVERING MSZO311 AND MSZO312)

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

24. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications 6th Edition, by Freshney, R. Ian Freshney, Wiley India Pvt. Ltd
25. Animal cell culture by Ravi, Samanthi Publication,
26. Animal Cell Culture: Essential Methods, John M. Davis (Editor) ,John Wiley & Sons Animal cell culture concept and application by Sharma, S, 2012, Scientific publisher, Jodhpur
27. Animal tissue culture , by Aruni, A.W, 2011- Scientific publisher
28. Cell and tissue culture (HB) – by C.K.Arora and M Prakash –Anmol publication –
29. Animal cell culture – concept and application – S.M Bhatt – Alpha science international ltd.
30. Cell culture techniques – (PB) – by Swati Rauthan – Lambert academic publishing
31. Lab Manual in Biochemistry, Immunology and Biotechnology -Arti Nigam Book

MSZO 313A: ENVIRONMENTAL BIOLOGY I	
UNIT - 1	Ecosystem – Dynamics, Management and stability, homeostasis, niche and its overlapping .Biosphere – composition and characteristics and types - Lithosphere, hydrosphere and atmosphere.
UNIT - 2	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.
UNIT - 3	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
UNIT - 4	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)
UNIT - 5	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

MSZO 314A: ENVIRONMENTAL BIOLOGY II	
UNIT - 1	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
UNIT - 2	Sustainable development – concept, strategies, principles, threats, and Commissions (national and internationals). Unsustainability – concept cause, effect
UNIT - 3	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.
UNIT - 4	Natural resources- Management, monitory and conservation, watershed and wetland management, Energy crisis
UNIT - 5	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

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED
1.	Experiment A	15
2.	Experiment B	15
3.	Spot 5 x 3	15
4.	Preparation	10
5.	CCA	30
6.	Slide preparation and submission	05
7.	Viva voice	10
	TOTAL	100

SUGGESTED READINGS

1. Environmental Law for the Built Environment by Jack Rostron
2. Fundamental of Ecology by Odum

3. Environment Protection and the Law by Dr. R K Khitoliya
4. Environmental Studies by Singh, Thakur & chauhan
5. Concepts of Ecology by Edward J. Kormondy
6. Ecology, Environment & Pollution - P K Gupta
7. Ecology and Environment by P D Sharma
8. Modern Concept of Ecology by H D Kumar
9. Biodiversity: Science and Development by Castri, f d & Younes
10. Environment and Ecology by R. Rajgopalan – Oxford India publication
11. Diversity Management: Theoretical Perspectives and Practical Approaches- Dr. Sheying Chen
12. Biodiversity by E O Wilson
13. Diversity of life by E O Wilson
14. Threatened Animals of India- B K Tikadar
15. Environmental science – A Practical manual – I.g Swarjya –PB- B.S Publication
16. Practical skills in Environmental science – PB – by Allen Jones
17. Water analysis – by N.K Dutta (HB) Eastern book house
18. Handbook of water and waste water analysis – by Kanwaljeet Kaur (HB) –Atlantic publisher
19. Manual of soil, plant & water analysis –Tahar Ali and Sumiti Naryan – Daya Publishing house
20. Manual of soil, plant and water analysis – by Dhyan singh – Westville publishing house –
21. Soil analysis –P.C Bandyopadhyay (HB) Daya Publishing house
22. Modern methods in environmental pollution analysis- Harh Kumar – Sarup and sons
23. Principles and practices of air pollution, control & analysis –J.R Mundakavi –IK P. house
24. Environmental pollution analysis - S.M Khopkar – PB- New Age publication
25. Handbook of methods in Environmental studies – water and waste water analysis –S.K Maiti – vol I and II – Oxford Book Company
26. 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

MSZO 313B: ENTOMOLOGY-I (INSECT- STRUCTURE & FUNCTION)	
UNIT - 1	Insect morphology - Head- Structure & Different Mouth parts. Thorax- Appendages, Wings & Wing venation, Flight Mechanism, Abdomen & its Appendages
UNIT - 2	Structure & Function of Alimentary Canal & Associated glands, Feeding, Nutrition, Digestion and Absorption
UNIT - 3	Excretory organs, Elimination of Nitrogenous Waste, Salt and water regulation, Detoxification
UNIT - 4	Tracheal system & Respiration in Terrestrial Insects. Respiration in Aquatic insects & Endoparasitic insects
UNIT - 5	Circulatory system, Composition and function of Haemolymph, Insect immunity

MSZO 314B: ENTOMOLOGY-II (SYSTEMATICS, ECOLOGY AND ECONOMIC ENTOMOLOGY)	
UNIT - 1	Systematics- Classification, habit, habitat and distinguishing characters of different orders of class insect (up to major families.) 1. Thysanura 2. Collembolla 3. Thysanoptera 4. Hemiptera 5. Lepidoptera 6. Isoptera
UNIT - 2	Ecology-Intraspecific & Interspecific relations, Social behavior in Hymenoptera and Isoptera, Effect of various Abiotic factors on Insect life
UNIT - 3	Medical entomology- Morphology, Vectorship, Pathogenecity, & Control of – 1. *Anopheles, Culex, Aedes*- (Mosquito)

	2. *Musca* (Housefly) 3. *Xenopsylla* (Rat flea) 4. *Pediculus* – (Human louse) Veterinary entomology- Morphology, vectorship, pathogenecity, & control of 1. *Tabanus* (Horse fly) 2. *Stomoxys* (Stable fly)
UNIT - 4	Industrial entomology - Biology Cultivation of beneficial insects - 1. *Laccifera lacca* 2. *Bombyx mori* 3. *Apis sps*
UNIT - 5	Household pests:-Morphology, damage caused & control measures - 1. Cockroach 2. Cricket 3. Ants & termites 4. Bedbugs 5. Silver fish 6. Carpet beetle

MSZO322B PRACTICAL
(COVERING MSZO313B AND MSZO314B)

1. To study variations and different modifications of external morphology of insect
2. To study variations and different modifications of Antennae, Mouth parts, Wings, Legs, genetalia & ovipositor of different insects
3. Study of effect of abiotic factors on insects life
4. To study different developmental stages of life cycle of mulberry silk worm (*Bombyx mori*) & lac insects (*Laccifer lacca*)
5. To study different developmental stages of life cycle of stored grain pests- *Oryzaephilus/ Callosobruchus/ Rhyzopertha / Sitophilus*
6. To study different developmental stages of life cycle of Butterfly (Daniadae / Papilionidae)
7. To study the food preference of *Tribolium* in different food grains.
8. To study different types of insects traps.
9. ***To study haemolymph of cockroach and identification of different types of haemocytes***
10. Mounting:- Antennae, Mouth parts, Wings, Legs, genitalia & ovipositor of different Insects.
11. Dissection of Digestive system & nervous system of-
    1. *Gryllus*
    2. Cockroach
12. Insect's collection, preservation & identification (**20** insects) of the orders Hemiptera, Lepidoptera, Isoptera.
13. Identification of different insect upto families using dichotomous key.
14. Preparation and submission of **10** permanent entomological slides
15. Preparation of Synopsis of assigned Project Work

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED	TIME DURATION
1.	Dissection	15	6 HRS
2.	Slide Preparation	10	6 HRS

3.	Spots (5 x 3)	15	6 HRS
4.	Collection of insects, preservation & identification	10	6 HRS
5.	CCA	30	6 HRS
6.	Slide Submission (10 Slides)	05	6 HRS
7.	Viva Voice	10	6 HRS
8.	Identification from dichotomous key	05	6 HRS
	TOTAL	100	

SUGGESTED READINGS

1. Agricultural Pests of India and South-East Asia - A. S. Atwal, Publisher- Kalyani Publishers, 1986
2. Forest Entomology - William Ciesla, Publisher- John Wiley & Sons, 2011
3. Useful and Destructive Insects by Matcalf & filt
4. Elements of Entomology- Rajendra Singh- Rastogi Publications.
5. Imms General text book of Entomology, Eds. O. W. Richards and R. G. Davis Chapman and Hall, London.
6. Applied Entomology by Nigum & Kumar
7. Introduction to General and Applied *Entomology* by V B Avasthi
8. General and Applied Entomology, K.K. Nayar, T. N. Ananthkrishan and B.V. Davis, Tata McGraw -Hill Co.Ltd. Bombay.
9. The Insect: Structure and function, R.F. Chapman, Cambridge University Press.
10. The Physiology of Insect , Ed. M.Rockstein ,Vol, 1-5, Academic Press, New York.
11. Analytical Biochemistry of Insect, Ed. R. B. Turner, Elsevier, Amsterdam.
12. A Text Book of General Entomology by M.S. Mani
13. Modem Entomology by Tembhare, D.B.
14. How to Know The Insects. 1978 , by Roger Bland and H. E. Jaques. 3rd edition, Waveland Press, Inc.
15. How to Collect and Preserve Insects: Guide Leaflet Series, No. 39 - Frank Eugene Lutz (Author) , Publisher: Literary Licensing, LLC (Aug 25 2012),
16. Handbook of Entomology- M. R. Dhingra, Publisher- Oxford Book Company,
17. Medical Entomology for Students - Mike Service (Author), Publisher: Cambridge University Press; 4 edition,
18. Handbook of Medical Entomology- William A. Riley, Publisher- Dyson Press, 2009,
19. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods- B.F. Eldridge, J.D. Edman, Publisher- Springer, 2003,
20. Handbook of Medical Entomology- O. A. 1870-1961 Johannsen, William Albert Riley, Publisher- BiblioBazaar, 2011,
21. Ray, D.N. and A.W.A. Brown : Entomology Medical & Veterinary
22. Bursel, E. : An Introduction to Insect Physiology
23. Rockstein M. : The Physiology of Insects (Vol. 1–VI)
24. Shrivastava, K.P. : A Text Book of Applied Entomology (Vol.I–H)
25. Ross, H.A. : Text Book of Entomology
26. Practical entomology: a guide to collecting butterflies, moths and other insects *Wayside and woodland series* - Richard L. E. Ford, Publisher- F. Warne, 1963,
27. Forensic Entomology: The Utility of Arthropods in Legal Investigations, Second Edition, Jason H. Byrd (Editor), James L. Castner (Editor), Publisher: CRC Press; 2 edition

MSC ZOOLOGY IV SEMESTER

CODE	DESCRIPTION	PD/ W	EXAM	CIA	ESE	TOTAL
MSZO 411	CHORDATE BIOLOGY II	6	3hrs	30	70	100
MSZO412	APPLIED ZOOLOGY – ITS TOOLS AND TECHNIQUES	6	3hrs	30	70	100
MSZO 413A / MSZO 413B	ENVIRONMENTAL BIOLOGY I / ENTOMOLOGY-I (INSECTS- FUNCTION AND DEVELOPMENT)	3/ 3	3hrs	30	70	100
MSZO414A / MSZO 414B	ENVIRONMENTAL BIOLOGY II / ENTOMOLOGY-II (SYSTEMATICS, AGRICULTURE ENTOMOLOGY AND PEST MANAGEMENT)	3/ 3	3hrs	30	70	100
MSZO421	PRACTICAL	12	5hrs	30	70	100
MSZO422A	PRACTICAL	12	5 hrs	30	70	100
MSZO422B	CHORDATE BIOLOGY II	12	5 hrs	30	70	100
TOTAL				180	420	600

MSZO 411: CHORDATE BIOLOGY I	
UNIT - 1	Origin of birds, Affinities, Feathers in birds, Mechanism of flight in birds, Flightless birds, Palate, Aquatic birds
UNIT - 2	Types of Beaks and Claws in birds, Parental Care in Birds, Migration in birds, Economic importance of birds, connecting link- *Archaeopteryx*
UNIT - 3	Origin and Classification (up to sub orders) of Mammals- Prototheria, Metatheria and Eutheria, Parental care in Mammals, Aquatic Mammals, Dentition in Mammals
UNIT - 4	Flying mammals (Chiroptera) and their adaptation, Comparative account of Old & New world Monkeys, Ancestory of Horse
UNIT - 5	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

MSZO 412: APPLIED ZOOLOGY – ITS TOOLS & TECHNIQUES	
UNIT - 1	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 spectophotometer
UNIT - 2	Medical Zoology: Host- Parasite relationship. Mode of infection & pathogenicity of following pathogens with reference to main prophylaxis and treatment – Plasmodium , Giardia, *Schistosoma,*Wuchereria, Taenia, Enterobius
UNIT - 3	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
UNIT - 4	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
UNIT - 5	Population dynamics of Insect Pests, Principles of biological, chemical, mechanicals, Cultural control of pest, Integrated Pest Management

MSZO 421: PRACTICALS

A. Dissection

4. *Labeo* / ***Cirrhinus mrigala - cranial nerve and & Webarian organs***
5. *Clarias, Ophiocephalus*, *Anabas,* ***Heteropneustes (Saccobranchus)*** -Accessory Respiratory organs & Webarian organs.

B. Osteology of representative classes- Aves and Mammals.

C. Permanent Slides

4. Histology of various Mammal organs- Liver, Intestine, Duodenum, Stomach, Spleen, Kidney, Ovary, Testis.
5. Reptiles- V.S. skin
6. Aves- Various types of Feathers

D. Permanent stain preparation- Cycloid and Ctenoid Scales, Sting of Honey bee, Ticks and mites, Aphids, *Pediculus*.

E . Museum Specimens

5. Amphibia: *Necturus, Amphiuma, Ambystoma,* Axolotal Larva,
6. Reptiles : *Ophiosaurus, Naja, Bungarus, Echis, Hydrophis, Eryx, Python, Crocodilus, Gavialis*
7. Aves: *Columba, Pavo, Choriotis*
8. Mammals: *Funambulus, Rattus, Suncus, Maccaca.* ***Semnopithecus (Gray Langur)***

F. To study diversity of beaks in birds

G. To study diversity of feet in birds

H. Report on Public awareness about environmental issues

I. ***Visit to scientific organizations/institutes.***

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED
1.	Dissection	15
2.	Spots (5 x 3)	15
3.	Preparation	10
4.	CCA	30
5.	Awareness File	10
6.	Local Visit and its report	10
7.	Viva Voice	10
	TOTAL	100

SUGGESTED READINGS

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

19. Handbook of Medical Entomology- O. A. 1870-1961 Johannsen, William Albert Riley, Publisher- BiblioBazaar, 2011

MSZO 413A: ENVIRONMENTAL BIOLOGY I	
UNIT - 1	Population Ecology – Definition, Density, Mortality, Natality, population fluctuation, dispersal, equilibrium, age pyramid, distribution, growth curve. Factors affecting population growth and regulation
UNIT - 2	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
UNIT - 3	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
UNIT - 4	Impact of environmental pollution – Global warming, Acid rain, Green house effect, Ozone layer depletion, Solid Waste – Disposal & Management
UNIT - 5	Ecotoxicology – Introduction, types of ecotoxicants, Dose –Response Relationship. Toxic effects and impact from individual to ecosystem

MSZO 414A: ENVIRONMENTAL BIOLOGY II	
UNIT - 1	Bioaccumulation, Biomagnification, Bioremediation – Need, merits, scope and current status. Biodegradation – plastic and pesticides
UNIT - 2	Health Hazards – Pesticides, Heavy metals, Dyes, Detergents and Fertilizers. Monitoring and remedial measures to control these pollutants
UNIT - 3	Environment Impact Assessment (EIA) – Concept, objectives, components, methodology, Environment Appraisal committees. Benefits of EIA Process
UNIT - 4	Remote Sensing – Introduction, physical basis for remote sensing, process, specified remote sensing satellites , system for data collection. Application & advantages of remote sensing.
UNIT - 5	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

MSZO 422A: PRACTICALS

1. Biomass and population density of terrestrial group, sampling and statistical analysis.
2. Measurement of potassium in water using flame photometer.
3. **Measurement of Calcium in water using flame photometer**.
4. Measurement of Chloride in water
5. Measurement of Silicate in water
6. Estimation of water quality index
7. ***Assessing the noise pollution level.***
8. ***Assessing the respirable particulate matter (PM_{10})/ fine particulate matter (PM2.5) in ambient air***
9. ***Assessing the gaseous pollutants (SO_2, NO_2), and ozone in ambient air.***
10. Identification and study of different migratory birds of this region
11. Visit to environmental important site.
12. Project Report

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED
1.	Experiment A	15
2.	Experiment B	10
3.	Experiment C	10
4.	Spots 5 x 3	15
5.	CCA	30
6.	Visit to environmental important file	10

7.	Viva Voice	10
	TOTAL	100

SUGGESTED READINGS

1. Environmental Law for the Built Environment by Jack Rostron
2. Fundamental of Ecology by Odum
3. Environment Protection and the Law by Dr. R K Khitoliya
4. Environmental Studies by Singh, Thakur & chauhan
5. Concepts of Ecology by Edward J. Kormondy
6. Ecology, Environment & Pollution by P K Gupta
7. Ecology and Environment by P D Sharma
8. Modern Concept of Ecology by H D Kumar
9. Threatened Animals of India by B K Tikadar
10. Environmental science – A Practical manual – I.g Swarjya –PB- B.S Publication
11. Practical skills in Environmental science – PB – by Allen Jones
12. Water analysis – by N.K Dutta (HB) Eastern book house
13. Handbook of water and waste water analysis – by Kanwaljeet Kaur (HB) –Atlantic publisher
14. Manual of soil, plant and water analysis – by Tahar Ali and Sumiti Naryan – Daya Publishing house
15. Manual of soil, plant and water analysis – by Dhyan singh – Westville publishing house –
16. Soil analysis – by P.C Bandyopadhyay (HB) Daya Publishing house
17. Modern methods in environmental pollution analysis- Harh Kumar – Sarup and sons
18. Principles and practices of air pollution , control and analysis – byJ.R Mundakavi –IK publishing house
19. Environmental pollution analysis – by- S.M Khopkar – PB- New Age publication
20. Handbook of methods in Environmental studies – water and waste water analysis – byS.K Maiti – vol I and II – Oxford Book Company
21. 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

MSZO 413B: ENTOMOLOGY I (INSECTS- FUNCTION AND DEVELOPMENT)	
UNIT - 1	Nervous System –**Structure** , Function and Anatomy, Brain, Transmission of nerve impulse in insects.
UNIT - 2	Endocrine System – Endocrine organs, Hormones and Pheromones, Endocrine control of Polymorphism in Insects
UNIT - 3	Perception of the Environment:- 1. Eyes - Compound eyes **and image formation** 2. Sound producing organs. 3. Light producing organs. 4. Thermoregulation
UNIT - 4	Reproduction in Insects. 1. **Reproductive** System male. 2. **Reproductive** System female 3. Insects Embryology – Egg and its development upto formation of extra embryonic membranes, viviparity, Polyembryony, Parthenogenesis and Paedogenesis
UNIT - 5	Post embryonic Development:- 1. Hatching 2. Metamorphosis a. Larval development and types of larvae b. Pupal development and types of pupae 3. Control of post embryonic development 4. Diapause

MSZO 414B: ENTOMOLOGY II
(SYSTEMATICS, AGRICULTURE ENTOMOLOGY AND PEST MANAGEMENT)

UNIT - 1	Systematics Classification, habit, habitat and distinguishing characters of different order**s** of class Insecta classification up to major families. 1. Odonata 2. Orthoptera 3. Diptera 4. Hymenoptera 5. Coleoptera
UNIT - 2	Agriculture entomology - I Systematic position, morphology, Damage and Control Measures of – 1. Pests of Vegetables & Fruits ;- a. *Dacus cucurbitae* (Melon fly) b. *Papilio demoleus* (Lemon butterfly) 2. Pests of Sugarcane:- a. *Pyrilla perpusilla* (Sugarcane leaf hopper) b. *Scirpophaga novella* (Sugarcane top borer) 3. Pests of pulses and oilseeds;- a. *Helicoverpa armigera* (Cotton boll worm) b. *Lipaphis erysimi* (Mustard Aphid) 4. Polyphagus Pests :- a. *Schistocerca gregaria* (Desert Locust) b. *Locusta migratoria* (Migratory Locust)
UNIT - 3	Agriculture entomology - II 1. Pests of cereals :- a. *Mythimna seperata* (Northern armyworm) b. *Sitobion avenae* (Wheat Aphid) 2. Pests of fiber crop:- a. *Pectinophora gossypiella* (Pink boll worm) b. *Dysdercus koenigii* (Cotton stainer) 3. Pests of paddy:- a. *Dicladispa armigera* (Spiny Leaf Beetle) b. *Spodoptera spp*(African army worm) 4. Pests of stored grains:- a. *Rhyzopertha dominica* (Lesser Grain Borer) b. *Tribolium spp* (Red Flour Beetles)
UNIT - 4	Forensic entomology: 1. Introduction 2. Insects of forensic importance 3. Entomological evidence collection during death investigations 4. Forensic entomological decomposition 5. Preliminary Idea about Post Mortem Interval (PMI) 6. Preliminary idea about some forensic important insects- Flies & Beetles
UNIT - 5	Pests management 1. Concept of Pests. 2. Physical, Mechanical, Cultural & Biological Control. 3. Modern methods of Control. 4. Integrated pest management (IPM) 5. Brief idea about Control of Bees and Wasps

MSZO 422B: PRACTICALS
1. Culture of *Drosophila* and study of its different developmental stages of life cycle. 2. To isolate and mount salivary glands of *Drosophila*. 3. To identify male and female individual from the given Grasshopper set.

4. To study artificial bee hive structure and its different parts.
5. To study different plant protecting equipments. (Spraying & Dusting)
6. Method of formulation and dilution of different insecticides.
7. Study of different castes of honey bee and termite.
8. To study structure of termitarium / Bee Hive/ Wasp Hive
9. Mounting : sting apparatus of Honey bee/ Wasp**, mouthparts of housefly, mouth parts of mosquito.**
10. To identify and locate tympanum of Grasshopper
11. Dissection :- Digestive and Nervous System of
    a. Grasshopper
    b. Honey bee
    c. Wasp
12. Insect Collection, preservation and identification of insects. **20** different insects of - Odonata, Orthoptera, Diptera, Hymenoptera, Coleoptera.
13. Identification of different order of insects up to families by using dichotomous keys.
14. Preparation and submission of **10** permanent entomological slides
15. Project Report/ Presentation

S NO	DISTRIBUTION OF MARKS	MARKS ALLOTTED
1.	Dissection	15
2.	Slide preparation	10
3.	Spots(5 spots X 3)	15
4.	Collection of insects, preservation & identification	10
5.	CCA	30
6.	Slide submission (10 slides)	05
7.	Viva voice	10
8.	Identification from dichotomous key.	05
	TOTAL	100

SUGGESTED READINGS

1. Modern Entomology (Second edition): D. B. Tembhare, Himalaya Publication House, Bombay.
2. 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.
3. Text Book of Entomology, K. P. Shivastava, Vol. 1 And 2 Kalyani Publication, Ludhiana.
4. Agriculture Entomology, H. S. Dennis, Timber Press Inc.
5. A Text Book of Agricultural Entomology ESSIG : College Entomology by Hemsingh Pruthi
6. Entomology: At a Glance Volume 2 Objective Fundamentals- R.C. Saxena, Agrotech Publishing,
7. The Science of Entomology. William S. Romoser and John G. Stoffolano, Jr. Fourth edition. WBC/McGraw-Hill, Boston, MA 1998
8. **Oldroyd**, N. : A Collection, Preserving and Studying Insects
9. Roger P. and Anderson : Forest and Shade Tree Entomology
10. Fradt, R.E. : Fundamentals of Applied Entomology
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