

**M.SC ZOOLOGY III SEMESTER**  
**[[July 2019- December 2019 (ESE Winter 2019)]]**

CODE	DESCRIPTION	PD/W	EXAM	CCA	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

**MSZO311 CHORDATE BIOLOGY I**

**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.

**Unit: - 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.

**Unit:- III** Classification, Origin and Adaptive Radiations in Amphibia, Extinct Amphibia (Stegocephalia), Parental care in Amphibia, Neoteny & Paedogenesis.

**Unit: - 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.

**Unit 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.

**MSZO312 VERTEBRATE IMMUNOLOGY AND ANIMAL CELL CULTURE**

**Unit: - I** Types of Immunities - Innate, Acquired, Active, Passive. Hematopoiesis. Cells of Immune system and their differentiation, Organization and structure of Primary and Secondary lymphoid organs.

**Unit: - 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.

**Unit: - 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.

**Unit: - IV** Regulation of immune response, antigen processing and presentation, Hypersensitivity and its types, Autoimmune disorders (Autoimmunity), Immunodeficiency and AIDS, Hybridoma technology and production of monoclonal antibodies.

**Unit: - 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.

**MSZO321 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. oral hood, 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:-*Balanoglossus*
2. Urochordate:- *Salpa*, *Doliolum*, *Oikopleura*, *Herdmania*

3. Cephalochordate:- *Petromyzon, Myxine*
  4. Pisces: *Zygaena, Scoliodon, Pristis, Torpedo, Trygon, Belone, Exocoetus, Anabas, Echeneis*
- G. Microtomy- Microtomy of different organs of Rat- Liver, Lung, Kidney, Intestine, Stomach, Heart, Testis, Ovaries  
(Submission of 15 Microtomy Slides)

### Marking Scheme

Distribution of Marks	Marks allotted	Time Duration - 6 hrs
1. Dissection	20	
2. Spots (5 spots x 3)	15	
3. <b>Immunological</b> exercise	10	
4. <b>CCA</b>	<b>30</b>	
5. Microtomy	15	
6. Viva voice	10	
Total	100	

### Suggested readings

#### (COVERING MSZO311 AND MSZO312)

1. Text book of Zoology Vol-11 Vertebrates – Parker & Haswell (Edited by Marshall & Williams) ( ELBS & Macmillan)
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 Immunology – 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 Cunningham , 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

### MSZO313A ENVIRONMENTAL BIOLOGY I

**Unit I:-** Ecosystem – Dynamics, Management and stability, homeostasis, niche and its overlapping .Biosphere – composition and characteristics and types - Lithosphere, hydrosphere and atmosphere.

**Unit: - 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.

**Unit: - 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.

**Unit 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)

**Unit V:-** National parks and sanctuaries- with reference to Corbett, Ranthambore, Manas, Desert National Park, Tal Chhappar Sanctuary, Keoladev National Park. Biosphere reserves- with reference to Nanda devi, Agasthiayamalai, Dibru-Saikhowa, Nilgiri, Panchmarhi, and Sunderbans.

#### MSZO314A ENVIRONMENTAL BIOLOGY II

**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.

**Unit II:-**Sustainable development – concept, strategies, principles, threats, and Commissions ( national and internationals). Unsustainability – concept cause, effect

**Unit 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.

**Unit IV:-** Natural resources- Management, monitory and conservation, watershed and wetland management, Energy crisis

**Unit 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.

#### MSZO322A PRACTICAL

##### (COVERING MSZO313A AND MSZO314A)

1. Measurement of Dissolved oxygen in water ,
2. Measurement of free carbon dioxide in water
3. Measurement of Total Alkalinity in water
4. Measurement of Sodium in water using flame photometric method.
5. Measurement of Sulphide in water
6. Measurement of Nitrate in water
7. Measurement of phosphate in water
8. Estimation of biochemical oxygen demand (BOD).
9. Estimation of chemical oxygen demand (COD).
10. Zooplankton identification, count, and its *diversity study*
11. Estimation of Soil variables- EC ( Electrical conductivity ), Phosphate and Nitrate

<b>Marking scheme</b>	<b>Maximum marks 100</b>
<b>Distribution of Marks</b>	<b>Marks allotted</b>
1. Experiment A	15
2. Experiment B	15
3. Spots 5 x 3	15
4. Preparation	10
5. CCA	<b>30</b>
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 Dhyansingh – 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

**MSZO313B ENTOMOLOGY-I  
(INSECT- STRUCTURE & FUNCTION)**

**Unit-I:** Insect morphology - Head- Structure & Different Mouth parts. Thorax- Appendages, Wings & Wing venation, Flight Mechanism, Abdomen & its Appendages

**Unit-II:** Structure & Function of Alimentary Canal & Associated glands, Feeding, Nutrition, Digestion and Absorption

**Unit-III:** Excretory organs, Elimination of Nitrogenous Waste, Salt and water regulation, Detoxification

**Unit-IV:** Tracheal system & Respiration in Terrestrial Insects. Respiration in Aquatic insects & Endoparasitic insects.

**Unit-V:** Circulatory system, Composition and function of Haemolymph, Insect immunity.

**MSZO314B ENTOMOLOGY-II  
(SYSTEMATICS, ECOLOGY AND ECONOMIC ENTOMOLOGY)**

**Unit-I:** 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-II:**-Ecology-Intraspecific & Interspecific relations, Social behavior in Hymenoptera and Isoptera, Effect of various Abiotic factors on Insect life.

**Unit-III:** 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-IV:** Industrial entomology - Biology Cultivation of beneficial insects -

1. *Laccifera lacca*
2. *Bombyx mori*
3. *Apis sps.*

**Unit-V:** 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, genitalia & 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

**Marking scheme** **Maximum marks 100 Time duration 6 hrs**

<b>Distribution of Marks</b>	<b>Marks allotted</b>
1. Dissection	15
2. Slide preparation-	10
3. Spots (5 spots X 3)	15
4. Collection of insects, preservation & identification-	10
<b>5. CCA</b>	<b>30</b>
6. Slide submission(10 slides)	05
7. Viva voice	10
8. Identification from dichotomous key	05
<b>Total</b>	<b>100</b>

**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 & filit
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. Modern 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