

CBCS SYLLABUS
(w.e.f. ACADEMIC YEAR 2022-23)

FOR
POST-GRADUATE DEGREE PROGRAMME


Master of Science
in Zoology

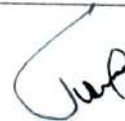
I to IV Semester

OF
PALAMURU UNIVERSITY

Chairperson,
BoS in Zoology

Palamuru University
Mahabubnagar - 509 001
Telangana State


CHAIRPERSON
Board of Studies in Zoology
Osmania University. HYD-7.





MINUTES OF THE MEETING OF BOARD OF STUDIES IN ZOOLOGY

PALAMURU UNIVERSITY, MAHABUBNAGAR, HELD ON DT: 05.08.2022 AT 11:00 AM

The following members wear present

- | | |
|--|----------|
| 1. Prof. M. Madhavi, Dept. of Zoology, UCS, OU | Chairman |
| 2. Dr. J. Venkateshwar Rao, Dept. of Zoology, UCS, OU | Member |
| 3. Prof. G. Sunitha Devi, Dept. of Zoology, UCS, OU | Member |
| 4. Sri. B. Ravinder Rao, Dept. of Zoology, Dr. BRR Degree College, Jadcherla | Member |

The members met on 05.08.2022 at Department of Zoology, Osmania University and discussed about the semester wise syllabi under CBCS for PG (Zoology) to be implemented from the academic year 2022-23 onwards at all the colleges under the jurisdiction of Palamuru University, Mahabubnagar.

It is resolved to unanimously approve the PG (Zoology) theory and practical syllabi semester – I to IV along with model papers

Member:

Signature

1. Prof. M. Madhavi, Dept. of Zoology, UCS, OU

2. Dr. J. Venkateshwar Rao, Dept. of Zoology, UCS, OU

3. Prof. G. Sunitha Devi, Dept. of Zoology, UCS, OU

4. Sri. B. Ravinder Rao, Dept. of Zoology, Dr. BRR Degree College, Jadcherla


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Department of Zoology, Palamuru University
 Two Year M.Sc. (Zoology) Programme w.e.f. AY 2022-2023 onwards

Proposed Scheme for Choice Based Credit System

Semester I					Semester II					Semester III					Semester IV				
Course	Hrs /Wk	Credits	Marks		Course	Hrs /Wk	Credits	Marks		Course	Hrs /Wk	Credits	Marks		Course	Hrs /Wk	Credits	Marks	
1 Core (SB) (Zoo_101T)	4	4	100	1	Core(TTB) (Zoo_201T)	4	4	100	1	Core (EC) (Zoo_301T)	4	4	100	1	Core (ABT) (Zoo_401T)	4	4	100	
2 Core (ECB) (Zoo_102T)	4	4	100	2	Core (AP) (Zoo_202T)	4	4	100	2	Paper - II(AB) (Zoo_302T)	4	4	100	2	Paper - II(BD) (Zoo_402T)	4	4	100	
3 Core(IIMM) (Zoo_103T)	4	4	100	3	Core (MGDB) (Zoo_203T)	4	4	100	3	Elective -I (Zoo_303T)	4	4	100	3	Elective -I (Zoo_403T)	4	4	100	
4 Core (BSFI) (Zoo_104T)	4	4	100	4	Core (ESFV) (Zoo_204T)	4	4	100	4	Elective -II (Zoo_304T)	4	4	100	4	Project				
5 Practical (SB) (Zoo_101P)	4	2	50	5	Practical (TTB) (Zoo_201P)	4	2	50	5	Practical (EC) (Zoo_301P)	4	2	50	4	Practical (ABT) (Zoo_401P)	4	2	50	
6 Practical (ECB) (Zoo_102P)	4	2	50	6	Practical (AP) (Zoo_202P)	4	2	50	6	Practical (AB) (Zoo_302P)	4	2	50	5	Practical (BD) (Zoo_402P)	4	2	50	
7 Practical (IIMM) (Zoo_103P)	4	2	50	7	Practical (MGDB) (Zoo_203P)	4	2	50	7	Elective -I (Zoo_303P)	4	2	50	6	Elective -I (Zoo_403P)	4	2	50	
8 Practical(BSFI) (Zoo_104P)	4	2	50	8	Practical(ESFV) (Zoo_204P)	4	2	50	8	Elective -II (Zoo_304P)	4	2	50	7	Project (Pr) (Zoo_404Pr)	8	6	150	
Total	32	24	600		Total	32	24	600		Total	32	24	600		Total	32	24	600	


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Department of Zoology, Palamuru University
Two Year M.Sc. (Zoology) Programme w.e.f. AY 2022-2023 onwards

Semester- I	Semester-II	Semester-III	Semester- IV
101: Structural Biology 102: Environmental and Conservation Biology 103: Immunology 104: Biosystematics, Structure & Functions of Invertebrates	201: Tools, Techniques and Biostatistics 202: Animal Physiology 203: Molecular Genetics and Developmental Biology 204: Evolution, Structure and Functional of Vertebrates	301: Endocrinology 302: Animal behavior 303: Elective-I 304: Elective -II	401: Animal Biotechnology 402: Biodiversity 403: Elective-I 404: Project (Pr)

List of Elective Papers (Semester III & IV) for Choice Based Credit System

SEMESTER III		SEMESTER IV	
Elective - I	Elective - II	Elective - I	Project
303: Agricultural Entomology – I (AE – I) 303: Medical Entomology – I (ME – I) 303: Parasitology – I (PS – I) 303: Principle of Fisheries – I (PF – I) 303: Neuroscience – I (NS – I) 303: Comparative Animal Physiology – I (CAP – I)	304: Fish Biology 304: Sericulture [SER] 304: Applied Toxicology (AT)	403: Agricultural Entomology – II (AE – II) 403: Medical Entomology – II (ME – II) 403: Parasitology – II (PS – II) 403: Principle of Fisheries – II (PF – II) 403: Neuroscience – II (NS – II) 403: Comparative Animal Physiology – II (CAP – II)	Project (Pr)

NOTE:
 A college can offer any course from the available courses listed under the Elective - II for the Semester III based on the availability of infrastructure and faculty expertise. The course will be offered only when a minimum of 15 students opt for the said course.


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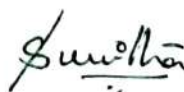


Scheme of ExaminationSemester – I

S.N.	Subject Code	Subject (Title)	Instruction Hrs/week	Duration of (hrs) Exam.	Max. Marks		Total Marks	Credits
					Internal Assessment	Semester Exam.		
1.	Zoo_101T	Structural Biology	4	3	20	80	100	4
2.	Zoo_102T	Environmental and Conservation Biology	4	3	20	80	100	4
3.	Zoo_103T	Immunology	4	3	20	80	100	4
4.	Zoo_104T	Biosystematics, Structure & Functions of Invertebrates	4	3	20	80	100	4
	PRACTICALS							
5.	Zoo_101P	Structural Biology	4	3	-	50	50	2
6.	Zoo_102P	Environmental and Conservation Biology	4	3	-	50	50	2
7.	Zoo_103P	Immunology	4	3	-	50	50	2
8.	Zoo_104P	Biosystematics, Structure & Functions of Invertebrates	4	3	-	50	50	2
Total:			32		80	520	600	24


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M.Sc. Zoology
DEPARTMENT OF ZOOLOGY, PALAMURU UNIVERSITY

Scheme of Examination

Semester – II

S.N.	Subject Code	Subject (Title)	Instruction Hrs/week	Duration of (hrs) Exam.	Max. Marks		Total Marks	Credits
					Internal Assessment	Semester Exam.		
1.	Zoo_201T	Tools, Techniques and Biostatistics	4	3	20	80	100	4
2.	Zoo_202T	Animal Physiology	4	3	20	80	100	4
3.	Zoo_203T	Molecular Genetics and Developmental Biology	4	3	20	80	100	4
4.	Zoo_204T	Evolution, Structure and Functions of Vertebrates	4	3	20	80	100	4
PRACTICALS								
5.	Zoo_201P	Tools, Techniques and Biostatistics	4	3	-	50	50	2
6.	Zoo_202P	Animal Physiology	4	3	-	50	50	2
7.	Zoo_203P	Molecular Genetics and Developmental Biology	4	3	-	50	50	2
8.	Zoo_204P	Evolution, Structure and Functions of Vertebrates	4	3	-	50	50	2
Total:			32		80	520	600	24


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M.Sc. Zoology
DEPARTMENT OF ZOOLOGY, PALAMURU UNIVERSITY


Scheme of Examination

Semester – III

S.N.	Subject Code	Subject (Title)	Instruction Hrs/week	Duration of (hrs) Exam.	Max. Marks		Total Marks	Credits
					Internal Assessment	Semester Exam.		
1.	Zoo_301T	Endocrinology	4	3	20	80	100	4
2.	Zoo_302T	Animal behaviour	4	3	20	80	100	4
3.	Zoo_303T	Elective - I	4	3	20	80	100	4
4.	Zoo_304T	Elective - II	4	3	20	80	100	4
PRACTICALS								
5.	Zoo_301P	Endocrinology	4	3	-	50	50	2
6.	Zoo_302P	Animal behaviour	4	3	-	50	50	2
7.	Zoo_303P	Elective - I	4	3	-	50	50	2
8.	Zoo_304P	Elective - II	4	3	-	50	50	2
Total:			32		80	520	600	24

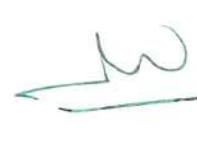
Note:

A college can offer any course from the available courses listed under the Elective - II for the Semester III based on the availability of infrastructure and faculty expertise. The course will be offered only when a minimum of 15 students opt for the said course.


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M.Sc. Zoology
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Scheme of Examination

Semester – IV


S.N.	Subject Code	Subject (Title)	Instruction Hrs/week	Duration of (hrs) Exam.	Max. Marks		Total Marks	Credits
					Internal Assessment	Semester Exam.		
	THEORY							
1.	Zoo_401T	Animal Biotechnology	4	3	20	80	100	4
2.	Zoo_402T	Biodiversity	4	3	20	80	100	4
3.	Zoo_403T	Elective - I	4	3	20	80	100	4
	PRACTICALS							
4.	Zoo_401P	Animal Biotechnology	4	3	-	50	50	2
5.	Zoo_402P	Biodiversity	4	3	-	50	50	2
6.	Zoo_403P	Elective - I	4	3	-	50	50	2
7.	Zoo_404Pr	Project	8	3	50	100	150	6
Total:			32		110	490	600	24


Credits and marks distribution for Project (Zoo_404pr)

	Credits	Marks
Internal Assessment		
Research Design	1	25
Completion Seminar	1	25
Semester-end Assessment		
Research work (Semester end test)	1	25
Dissertation, Final presentation & Viva	3	75
Total	6	150

Note:

The project offered in Semester IV carries 6 credits worth 150 marks.


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 Sumitha



Semester – I
CORE PAPER

Paper I: Structural Biology [SB]

- UNIT I – Basic concepts of Biomolecules and Structural Biology** 15 Hrs
- 1.1 Biomolecules and their significance – carbohydrates, proteins, amino acids, nucleic acids and lipids.
 - 1.2 Chemistry and structure of mono, oligo and polysaccharides; Deoxy sugars, amino sugars and glycosides.
 - 1.3 Classification and structures of proteins – primary, secondary, tertiary and quaternary.
 - 1.4 Classification, structure and function of lipids, fatty acids, triglycerides; phospholipids, cerebrosides, steroids.
 - 1.5 Nucleic acids – Structure of DNA and RNA, DNA polymorphism, RNA types.
- UNIT II – Enzymes and Metabolism** 15 Hrs
- 2.1 Classification, nomenclature and properties of enzymes – catalysis and energy of activation; Enzyme kinetics, Michaelis–Menten Constant; (K_m values) and LB plot; mechanism of enzyme action and regulation of enzyme activity.
 - 2.2 Metabolism of carbohydrates – Glycolysis; TCA cycle; Gluconeogenesis; biological oxidation; the role of the respiratory chain in energy capture; ATP synthesis.
 - 2.3 Catabolism of amino acids – Transamination, deamination and decarboxylation.
 - 2.4 Oxidation and biosynthesis of fatty acids.
 - 2.5 Metabolic disorders of different biomolecules (carbohydrates, proteins, lipids).
- UNIT III – Cellular Organization** 15 Hrs
- 3.1 Molecular organization and functions of cell membranes.
 - 3.2 Cell permeability – Transport across the cell membrane; transport of small molecules; Carrier proteins; Ion pumps; membrane-bound enzymes.
 - 3.3 Cell communications – Intercellular communication and gap junctions; chemical signalling between the cells; strategies of chemical signalling.
 - 3.4 Signalling mediated by intracellular receptors; signalling mediated cell surface receptors –second and third messengers; C-AMP, G-proteins, Ca^{++} , Inositol Triphosphate (IP_3) and prostaglandins.
 - 3.5 Cell cycle; molecular events in the cell cycle; mitotic spindle.
- UNIT IV – Synthetic Biology** 15 Hrs
- 4.1 DNA replication – Semi conservative, enzymology of DNA replication, replication of circular DNA, initiation, elongation and termination of replication process; Proofreading function of DNA polymerases.
 - 4.2 Enzymatic synthesis of RNA; Regulation of genetic code – Wobble's concept, translation in prokaryotes and eukaryotes.
 - 4.3 Protein synthesis – Events of protein synthesis; transcription in prokaryotes and eukaryotes; post-transcriptional processing.
 - 4.4 DNA repair mechanism – High fidelity of DNA sequence – Repair of damage caused by UV light, Eukaryotes repair systems.
 - 4.5 Synthetic genomics – Basics theoretical and computational modelling of the replicating system.

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New CBCS Syllabus for 2022-23 onwards

M.Sc. Zoology

PRACTICALS

- 1 Determination of proteins by Biuret method/ Folin Phenol method.
- 2 Determination of glucose by Somogyi / Anthrone method.
- 3 Determination of lipids by Vanillin method.
- 4 Determination of glycogen by Kemp's method.
- 5 Estimation of cholesterol.
- 6 Determination of enzyme activities of SDH and LDH.
- 7 Effect of substrate concentration and pH on SDH activity.
- 8 Protein fractionation using sodium sulphate.
- 9 Extraction of DNA and RNA.
- 10 Electrophoretic analysis of proteins/DNA.
- 11 Feulgen reaction method for DNA localization.
- 12 Preparation and characterization of a synthetic molecule.
- 13 Submission of assignment **To be submitted at the time of Internal Examination –[5 Marks]**

SUGGESTED BOOKS

- 1 Textbook of Biochemistry by Harper.
- 2 Textbook of Biochemistry by Lehninger.
- 3 Textbook of Biochemistry by Stryer and Stryer.
- 4 Textbook of Biochemistry by Conn and Stumpf.
- 5 Textbook of Biochemistry by A.B.V. Rama Rao.
- 6 Cell and molecular biology by De Robertis and De Robertis, 8th ed.
- 7 Molecular Biology by Friefielder.
- 8 Molecular cell biology by Darnell, Lodish and Baltimore (Scientific American Books).
- 9 Molecular biology by H. D. Kumar.
- 10 Biochemistry and molecular biology by W. H. Elliot and D.C. Elliot (OU Press).
- 11 Molecular Biology of Cell by Bruce Alberts et al.
- 12 Cell by Karp.
- 13 Synthetic Biology – Tools and Application by Humin Zhao





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Semester – I
CORE PAPER

Paper II: Environmental and Conservation Biology [ECB]

UNIT I – Basic Concepts of Ecology

15 Hrs

- 1.1 Laws of limiting factor, Laws of Minimum, Laws of Tolerance and Tragedy of Commons.
- 1.2 Types of ecosystems – Freshwater, marine and terrestrial.
- 1.3 Micronutrients and macronutrients.
- 1.4 Population characteristics and dynamics – A conceptual approach and Growth curves

UNIT II – Community Organization and Structure

15 Hrs

- 2.1 Community analysis, species diversity, ecotone concept and edge effect; ecological niche and niche overlap; the concept of biome.
- 2.2 Concepts of productivity; Biogeochemical cycles; eutrophication of lakes; biological indicator and water quality.
- 2.3 Pollution ecology: Inorganic pollutants and their impact SO_2 , NO_2 , CO, Phosphates, heavy metals (Arsenic, Lead and Mercury); radioactive nucleotides and their impact on the biological system.
- 2.4 Acid rain sources and its impact on the biological system; greenhouse effect and ozone depletion.

UNIT III – Biogeography of India, Habitats and Resources

15 Hrs

- 3.1 Classical concepts of biogeography – continental drift and Plato tectonic theory; endemism, refugia.
- 3.2 Biogeographical regions of India and their salient features.
- 3.3 Concepts of natural resources – renewable and non-renewable resources.
- 3.4 Overexploitation of resources – deforestation, water table depletion and land degradation.

UNIT IV – Natural Resource Management

15 Hrs

- 4.1 Environmental Impact Assessment – principle, scope and purpose.
- 4.2 Role of ecological restoration in conservation; displacement and settlement of local communities.
- 4.3 Major conservation movements in India; NGOs in conservation efforts.
- 4.4 National legislation for protecting biological resources

M.Sc. Zoology

PRACTICALS

- 1 Draw the biogeographical regions of India and provide in brief the salient features of each biogeographical zone.
- 2 Estimation of total alkalinity of water and soil.
- 3 Estimation of phosphates in the water sample.
- 4 Estimation of nitrates and nitrites in the water sample.
- 5 Estimation of magnesium in the water sample.
- 6 Estimation of calcium in the water sample.
- 7 Biological indicators of water quality and their population dynamics – Collection of the water sample.
- 8 Identification of zooplanktons, and their ecological significance.
- 9 Enumeration and identification of the freshwater biodiversity of the local habitats.
- 10 Enumeration and identification of the terrestrial biodiversity of the local habitats.
- 11 Estimation of particulate matter in the air.
- 12 Submission of assignment **To be submitted at the time of Examination – [5 Marks]**

Suggested Books

- 1 Caughley, G., and A. Gunn. 1996. Conservation Biology in Theory and Practice. Blackwell Science, Cambridge, Massachusetts, U.S.A.
- 2 Cox, G. W. 2005. Conservation Biology: Concepts and Applications. McGraw-Hill, Dubuque, Iowa, U.S.A.
- 3 Dasmann, R., 1981. Wildlife Biology, 2nd ed. John Wiley and Sons, NY.
- 4 Dobson, A. P. 1996. Conservation and Biodiversity. Scientific American Library, New York, New York, U.S.A.
- 5 Jeffries, M. J. 1997. Biodiversity and Conservation. Routledge, New York, New York, U.S.A.
- 6 Mills, L. Scott 2006. Conservation of Wildlife Populations. Blackwell Science, Oxford, U. K.
- 7 Milner-Gulland, E. J., and R. Mace. 1998. Conservation of Biological Resources. Blackwell Science, Oxford.
- 8 Morris, W. F., and D. F. Doak 2002. Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis. Sinauer Associates, Sunderland, Massachusetts, U.S.A.
- 9 Sinclair, A. R. E., J. M. Fryxell, and G. Caughley 2006. Wildlife Ecology, Conservation and Management, Blackwell Publishing.
- 10 Soulé ME (ed) 1986. Conservation biology: the science of scarcity and diversity- Sinauer, Sunderland.
- 11 Bram F. Noble 2005. Introduction to Environmental Impact Assessment: A Guide to Principles and Practice. Oxford University Press, London.
- 12 John A. Wiens and Michael R. Moss 2005. Issues and Perspectives in Landscape Ecology. Cambridge University Press, London.
- 13 Aparna Sawhney 2004. The New Face of Environmental Management in India. Ashgate Publishing Ltd., Sheffield.

- UNIT I – Introduction to Immunology** 15 Hrs
- 1.1 Evolution of Immune system - Invertebrates and Vertebrates.
 - 1.2 Immune system – Innate and adaptive immunity.
Humoral mediated immunity and cell-mediated immunity.
 - 1.3 Cells involved in the immune system, the role of macrophages in immunity
 - 1.4 The Lymphoid tissues – primary and secondary lymphoid organs, lymphatic traffic.
- UNIT II – Immunoglobulins and Complement system** 15 Hrs
- 2.1 Antigens nature, epitope, haptens, antigen-presenting cells, adjuvants. Antigenicity
 - 2.2 Immunoglobulin's structure, function and classification of antibodies.
 - 2.3 Monoclonal antibodies and their application.
Antigen antibody reactions immunological techniques-
Principles and application of ELISA, RIA, immunoprecipitation, FISH and GISH.
 - 2.4 Complement system – Components of the complement system, pathways classical and alternative, biological consequences of complement activation and complement significance.
- UNIT III – Hypersensitivity Reactions and Autoimmune Diseases** 15 Hrs
- 3.1 Hypersensitivity – Classification of hypersensitivity reactions;
Type – I – Anaphylactic hypersensitivity;
Type – II – Antibody-mediated cytotoxic hypersensitivity.
 - 3.2 Type – III – Immunocomplex mediated hypersensitivity.
Type – IV – Cell-mediated (Delayed) hypersensitivity.
 - 3.3 Autoimmune diseases – Organ-specific autoimmune diseases –
Grave's disease, insulin-dependent *diabetes mellitus* (type-I diabetes).
 - 3.4 Autoimmune diseases – Systemic autoimmune diseases –
Systemic Lupus Erythematosus (SLE), Rheumatoid arthritis.
- UNIT IV – Transplantation and Tumour Immunology** 15 Hrs
- 4.1 Transplantation – Barriers to transplantation.
 - 4.2 Genetic predisposition for graft rejection, prevention of rejection.
 - 4.3 Tumour immunology – Immunity to tumours, tumor Vaccine development and Immune based techniques.
 - 4.4 Immunosurveillance.


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M.Sc. Zoology

PRACTICALS

- 1 Slide agglutination test – A,B,O blood groups.
- 2 HIV test (Tridot method).
- 3 RDT Kit for Malaria/ Dengue (Source for kit – NVBDCP).
- 4 RPR Test for Syphilis.
- 5 Widal test for diagnosis of enteric fever.
- 6 Blood smear preparation and identification of lymphocytes.
- 7 Identification of histological slides of lymphoid tissues - Spleen, thymus, lymph node and bone marrow.
- 8 Single Radial immunodiffusion for estimating the concentration of antibodies and antigens.
- 9 Immunization schedules and rising of antibodies.
- 10 Demonstration of Immuno-electrophoresis.
- 11 Submission of assignment [To be submitted at the time of Internal Examination – [5 Marks]

Suggested Books

- 1 Immunology, Kuby, W.F. Freeman, U.S.A.
- 2 Fundamentals of Immunology, W. Paul.
- 3 Essentials of Immunology, I.M. Roitt.
- 4 Immunology A Foundation Text by Basiro Davey.
- 5 An introduction to immunology, by Ian R. Tizard.


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Semester – I
CORE PAPER

Paper IV: Biosystematics, Structure & Functions of Invertebrates

UNIT I – Advances in Taxonomy 15 Hrs

- 1.1 Basic concepts of biosystematics, taxonomy and classification; Branches of taxonomy – Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy, and Cladistics Taxonomy.
- 1.2 Taxonomic hierarchy of ranks; Species concepts – Biological, Evolutionary, and Phylogenetic.
- 1.3 Recent trends in biosystematics – Molecular taxonomy and Integrative approaches.
- 1.4 International Code for Zoological Nomenclature (ICZN) – Operative principles, interpretation and application of important rules.

UNIT II – Nutrition & Respiration in Invertebrates 15 Hrs


- 2.1 Patterns of feeding and digestion in metazoan
- 2.2 Filter feeding mechanism in polychaeta Reproduction and development in Cnidaria.
- 2.3 Modifications in the digestive system of invertebrates with special reference to Arthropoda & Mollusca Reproduction, development and larval forms of Platyhelminthes.
- 2.4 Respiration: Respiratory pigments, Organs of respiration-gills, trachea and lungs, mechanism of respiration

UNIT III – Excretory and Nervous systems in Invertebrates 15 Hrs

- 3.1 Organs of excretion- coelome, coelomoducts, Nephridia, Malpighian tubules. Mechanism of excretion and osmoregulation
- 3.2 Nervous system: Coelenterates and Echinodermata Shell and foot & their functions in Mollusca.
- 3.3 Nervous system: arthropods (Crustaceans and insects) and Molluscs Cephalopoda)
- 3.4 Eusociality in insects and Autotomy and regeneration in echinoderms.

UNIT IV – Minor Phyla 15 Hrs

- 4.1 General organization and affinities of Ctenophora, Nemertea, Bryozoa, Entoprocta, Chaetognatha
- 4.2 Larval forms of free-living invertebrates (Coelenterata, Annelida, Arthropoda, Mollusca and Echinodermata)
- 4.3 Larval forms of helminthes and crustacean
- 4.4 Evolutionary significance of larval forms.


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M.Sc. Zoology

PRACTICALS

- 1 Specimen studies - Salient characteristics, identification and classification of representative types of invertebrate groups from Protozoa, Porifera, Cnidaria, Ctenophora, Annelida, Mollusca, Arthropoda, Echinodermata, and Hemichordata.
- 2 Collection and identification of invertebrates in pond water.
- 3 Preparation of permanent slides of zooplanktons (minimum three different types of species).
- 4 Collection and identification of parasites from the cockroach.
- 5 Dissections -
 1. Minor – a) Reproductive system of cockroach, b) Mouthparts of cockroach
 2. Major – a) Nervous system of prawn
- 6 Submission of assignment **To be submitted at the time of Practical Examination – [5 Marks]**

Suggested Books

- 1 Principles of Systematic Zoology (2nd Edition) by E. Mayr and P.D. Ashlock.
- 2 Five Kingdoms - An Illustrated Guide to the Phyla of Life on Earth by Lynn Margulis & M.J. Chapman.
- 3 A Textbook of Zoology Vol. I by Parker and Haswell (Revised).
- 4 The Invertebrates Vol. I to Vol. VI by L. H. Hyman.
- 5 Invertebrate structure and function by E. J. W. Barrington.
- 6 Invertebrate Zoology by P. A. Meglitsch (Oxford Press).
- 7 Life of Invertebrates by Russel Hunter.
- 8 Invertebrate Zoology by Rupport and Barnes (Saunders College Publishing Co.).
- 9 Life of Invertebrates by S. N. Prasad.
- 10 Evolutionary Biology by Eric C. Mitkoff.
- 11 Worms and Man by D. W. T. Crompton.
- 12 Parasitology by Noble and Noble.
- 13 Regeneration by S. M. Rose-Appleton.





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Paper I: Tools, Techniques and Biostatistics [TTB]

UNIT I – Tools and Separation Techniques

15 Hrs

- 1.1 Principles of Microscopic Techniques: light, UV, confocal phase contrast, Fluorescent Microscopy; Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM).
- 1.2 Homogenization; cell fractionations; Types of Centrifugations, principles and applications of Preparative, analytical and ultra-centrifugation.
- 1.3 Chromatography Techniques; Adsorption Chromatography, TLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography.
- 1.4 Electrophoresis Techniques - Principles and applications of continuous disc, iso-electro focusing and isotachopheresis.

UNIT II – Separation and Imaging Techniques

15 Hrs

- 2.1 Spectroscopy Techniques: principles and applications: Fluorescence, UV, Visible, Infrared, NMR, Gc-MS, FTIR
- 2.2 Radioisotope Techniques: Principles and application of Geiger-Muller and scintillation counter. Principles and applications of tracer techniques in biology; radioactive isotopes and autoradiography.
- 2.3 Electrophysiological Techniques: Single neuron recording, patch-clamp recording.
- 2.4 Imaging Techniques: PET, MRI, fMRI, ECG and CAT.

UNIT III – Biostatics-I: Introduction, Measure and theories of probability

15 Hrs




- 3.1 Introduction to biostatistics; Statistical data & tabulation of data. Frequency distribution; graphical representation of data
- 3.2 Measures of central tendency – Mathematical average (Mean – Arithmetic, Geometric & Harmonic Mean) and Positional Averages (Median and Mode);
- 3.3 Measures of dispersion (or variability) – types, range, quartile deviation, mean deviation, variance, standard deviation, coefficient of variance.
- 3.4 Basics of Probability – Concept of probability, addition and multiplication laws of probability and application to the problems of biology. Normal, Binominal and Poisson distribution

UNIT IV – Biostatistics-II: Hypothesis testing and inferential statistics

15 Hrs

- 4.1 Sampling concept, sampling, distribution of mean, standard error, random variable concept, expectation and variance of random variable
- 4.2 Statistical estimations- types methods and application; statistical hypothesis- types testing (Hypothesis, Null Hypothesis, Alternative Hypothesis) Decision Making (Types -I Type -II errors), Determination (Fixation of levels of Significance)
- 4.3 Parametric tests- student's t-test; analysis of variance (ANOVA or F- ratiion one way and two way analysis); Chi-Square test (Test of independence and Test of Goodness of Fit)
- 4.4 Correlation and regression analysis concepts and their application


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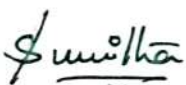

M.Sc. Zoology

PRACTICALS

- 1 To fix a tissue with Bouin's fixative and stain using hematoxylin-eosin stain for histochemical studies
- 2 Separation of AMINO ACIDS by paper chromatography
- 3 Quantitative detection of total carbohydrates using Anthrone technique
- 4 Quantitative detection of total lipids using sulpho-phosphovanillin technique
- 5 Quantitative detection of total proteins using Lowry et al's Biuret technique
- 6 Graphic presentation of data – bar diagram, histogram, frequency polygon and pie chart
- 7 Calculation of measures of central tendencies – mean, median and mode
- 8 Calculation of measures of dispersions – range, mean deviation, standard deviation, variance and coefficient of variance
- 9 Computation of test of significance – comparison of sample mean with population mean and two sample means.
- 10 Calculate the coefficient of correlation between two variable
- 11 Computation of liner regression
- 12 Computation of one way analysis of variance (ANOVA)
- 13 Using Chi Square test, test the independence of two variables
- 14 Submission of assignment [To be submitted at the time of INENRAL Examination – 5 Marks]

Suggested Books

- 1 Principles and techniques of Practical Biochemistry Ed. B.L. Williams & K. Wilson, Arnold Publishers
- 2 Practical Biochemistry by Plummer
- 3 Immunology – Roit
- 4 Cell and Molecular Biology – DeRobertis
- 5 Cell and Molecular Biology – Ladish et al.
- 6 Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press
- 7 Biometry by W. H. Freeman and Francisco
- 8 Fundamentals of Biometry by L.N. Balaram (1980)
- 9 Biostatistics by N. Gurumani
- 10 Techniques in life sciences – by Tembhare





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Semester – II
CORE PAPER

Paper II: Animal Physiology [AP]

- UNIT I – Digestion, Respiration & Circulation** **15 Hrs**
- 1.1 Cellulose digestion – Ruminant and non-ruminant digestion; absorption in mammals; events of absorptive and post-absorptive states and their regulation (endocrine and neural).
 - 1.2 Respiration – Cascade of oxygen transport to tissues at high altitude; adaptation to diving.
 - 1.3 Responses to CO₂ and O₂ rich environment; oxygen toxicity; hypercapnea, control of respiration.
 - 1.4 Circulation - Cardiac cycle and principles of hemodynamics; blood coagulation, haematome formation; Anti-coagulants.
- UNIT II – Osmoregulation, Excretion & Thermoregulation** **15 Hrs**
- 2.1 Osmoregulation – Osmoregulatory problems in brackish water, fresh water and marine organisms; osmotic problems in terrestrial animals; hormonal control of osmoregulation.
 - 2.2 Excretion – Urine formation, counter-current mechanism; juxtaglomerular apparatus, rennin-angiotensin system; hormonal regulation – ADH and aldosterone.
 - 2.3 Detoxification of nitrogen products; purine cycle and miscellaneous detoxification pathways.
 - 2.4 Thermal physiology – temperature regulation in poikilotherms, homeotherms and heterotherms, and their mechanisms of survival; central control of homeothermy.
- UNIT III – Muscle Physiology, Neurophysiology & Receptors** **15 Hrs**
- 3.1 Comparative molecular structure and function of skeletal, smooth and cardiac muscles; energy metabolism in skeletal muscle, muscle fatigue.
 - 3.2 Types of neurons and glial cells.
 - 3.3 Basis and significance of membrane potentials, equilibrium potentials, their change during the stimulus, Na, K currents in the action potential.
 - 3.4 Types of synapses, synaptic transmission - electrical and chemical; synaptic inhibition and neurotransmitters.
- UNIT IV – Endocrinology, Bioluminescence & Stress Physiology** **15 Hrs**
- 4.1 Structure and function of endocrine glands of invertebrate hormones.
 - 4.2 Structure and function of endocrine glands of invertebrate hormones.
 - 4.3 Mechanism of hormone action - Peptide and steroid hormones.
 - 4.4 Bioluminescence - Luminescent organisms - Neural control; Biochemistry and significance of luminescence.


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M.Sc. Zoology

PRACTICALS

- 1 Estimation of blood chlorides under hetero osmotic media.
- 2 Cold and heat stress on metabolic rate in tilapia fish/crab.
- 3 Effect of heat stress on glycogen levels in tilapia fish/crab.
- 4 Estimation of Acetylcholinesterase activity.
- 5 Estimation of phosphorylase activity.
- 6 Adrenalin and insulin induced changes in blood glucose levels in rat/mice.
- 7 Kymographic recordings of twitch, tetanus and fatigue.
- 8 Estimation of Hb, ESR and blood clotting time.
- 9 Cell fragility.
- 10 Submission of assignment. [To be submitted at the time of Internal Examination – 5 Marks]

Suggested Books

- 1 Principles of Animal Physiology by D.W. Wood.
- 2 Principles of Animal Physiology by Gordon.
- 3 Animal Physiology-Adaptations and environment by Schmidt-Nielson.
- 4 Principles of Animal Physiology by Wilson.
- 5 Text Book of Medical Physiology by Guyton.
- 6 General & Comparative Animal Physiology by William Hoar.
- 7 Comparative Animal Physiology by Florey.
- 8 Comparative Animal Physiology by L.C. Prosser.
- 9 Human Physiology by Vander.


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Semester II
CORE PAPER

Paper III: Molecular Genetics and Developmental Biology [MGDB]

UNIT I – Introduction to Genetics

15 Hrs

- 1.1 Mendelism; Mendelian inheritance; modification of mendelian inheritance.
- 1.2 Linkage studies, crossing over and extrachromosomal inheritance, multiple alleles blood group antigens, karyotype.
- 1.3 Genetic disorders – Chromosomal disorders; inborn errors metabolism, polygenic inheritance, pedigree analysis.
- 1.4 Bacterial genetics – Transformation, , conjugation, transduction, viral lytic and lysogenic cycle.

UNIT II – Molecular Genetics

15 Hrs

- 2.1 Introduction of DNA technology – Restriction endonucleases, methods of ligation – DNA ligases, ligation of the fragment with cohesive and blunt ends.
- 2.2 Features of vectors – Cosmids, plasmids and shuttle vector with one example representing each class construction and characterization of new cloning vectors.
- 2.3 Cloning strategies – Shotgun cloning, construction of gene libraries, genomic library and DNA library. DNA finger printing and its applications
- 2.4 Hybridization techniques – Southern blot, Northern blot, R-loop mapping methods, *In-situ* hybridization.

UNIT III – Overview of Developmental Biology

15 Hrs

- 3.1 Scope and importance of developmental biology.
- 3.2 Gametogenesis; spermatogenesis, oogenesis, vitellogenesis and chemo differentiation.
- 3.3 Fertilization, parthenogenesis and its significance.
- 3.4 Types of cleavage, mechanism of cleavage, chemical changes during cleavage.

UNIT IV – Organogenesis

15 Hrs

- 4.1 Gastrulation, metabolic events during gastrulation and rudimentary organs formation.
- 4.2 Concept of organisers and inducers; Neural tubule formation. Fate maps and stem cells
- 4.3 Role of hormones in the metamorphosis of insects and frog; regeneration in Cnidaria, Echinodermata, Amphibia (limb and tail regeneration), and Reptiles (tail regeneration).
- 4.4 Teratogenesis– Genetic and environmental; developmental mechanisms of teratogenesis


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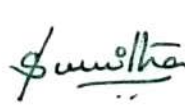

M.Sc. Zoology

PRACTICALS

- 1 Identification of blood groups: A, B, O.
- 2 Karyotyping of human chromosomes.
- 3 Isolation and estimation of DNA in tissue.
- 4 Isolation and estimation of RNA in tissue.
- 5 Estimation of soluble and structural proteins in chick embryo (any two durations) – 24hrs, 48hrs, 72hrs, &96hrs.
- 6 Estimation of SDH activity in chick embryo (any two durations) – 24hrs, 48hrs, 72hrs, &96hrs.
- 7 Estimation of LDH activity in chick embryo (any two durations) – 24hrs, 48hrs, 72hrs, &96hrs.
- 8 Estimation of calcium in eggshell by EDTA method (any two durations) – 24hrs, 48hrs, 72hrs, &96hrs.
- 9 Identification of chick embryo developmental stages (any two durations) – 24hrs, 48hrs, 72hrs, &96hrs.
- 10 Study of cleavage patterns in *Lymnaea*.
- 11 Submission of assignment **To be submitted at the time of Examination –[5 Marks]**

Suggested Books

- 1 General genetics by Winchester
- 2 Molecular Biology of gene by Watson et al. Vol I & II
- 3 Genetics by Strickberger
- 4 Molecular Biology by Friefielder
- 5 Genetics by P.K. Gupta
- 6 Genes by Lewis
- 7 General genetics by S. R. B. Owen
- 8 Cell and molecular biology by De Robertis and De Robertis, 8th ed.
- 11 Molecular cell biology by Darnell, Lodish and Baltimore (Scientific American books)
- 12 Molecular biology by H. D. Kumar
- 13 Biochemistry and molecular biology by W. H. Elliot and D.C.Elliot (OUPress)
- 14 Textbook of molecular biology by K. S. Sastry et al. (MacMillan Ind. Pvt. Ltd.)
- 15 Developmental Biology - patterns, problems and principles by W. Saunders Jr.
- 16 Principles of Animal Developmental Biology by S.C. Goel
- 17 Introduction to embryology by Balinsky
- 18 Developmental Biology S. Gilbert
- 19 Evolution by Savage
- 20 Process of organic evolution by Stebbings
- 21 Evolution of vertebrates by Colbert
- 22 Developmental Biology by Berryl





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Semester – II
CORE PAPER

Paper IV: Evolution & STRUCTURE AND FUNCTIONS OF VERTEBRATES [ESFV]

UNIT I – Evolution of Life

15 Hrs

- 1.1 Theories of evolution – Pre-Darwinian concepts, Darwinism, Neo-Darwinism.
- 1.2 Natural Selection and adaptation; Mutation – Its types, mutation rates; Variation and Genetic drift
- 1.3 Speciation – Reproductive isolation (pre-zygotic & post-zygotic), modes of speciation (Allopatric, Sympatric & Parapatric).
- 1.4 Patterns of evolution – Sequential, divergent, convergent, gradual, punctuated, monophyletic, polyphyletic & paraphyletic.

UNIT II – Evolution of Vertebrates

15 Hrs

- 2.1 Evolution of Agnathans – a) Extinct (Conodonts, Ostracoderms & Pteraspitomorphi) and b) Living (Myxinoidea & Petromyzontiformes).
- 2.2 Evolution of Gnathostomes – a) Placodermi and b) Chondrichthyes (including Elasmobranchii & Holocephali).
- 2.3 Evolution of Teleostomi – a) Acanthodii and b) Osteichthyes (Actinopterygii & Sarcopterygii).
- 2.4 Evolution Tetrapods – a) Labryinthodonts, b) Lepospondyls and c) Lissamphibia (Urodela, Anura & Apoda).
- 2.5 Evolution of Amniotes – a) Reptilia (Mesozoic and living reptiles), b) Aves (Palaeognathae & Neognathae) and c) Mammalia (Prototheria & Theriiformes).

UNIT III – Functional Anatomy – I


15 Hrs


- 3.1 Integumentary system – Integument and its derivatives.
- 3.2 Cranial skeletal system – a) Basic plan of skull; b) Temporal fossae – its function; c) Jaw suspension and its types.
- 3.3 Post-cranial skeletal system – a) Axial skeleton; b) Appendicular skeleton; c) Joints (both axial & appendicular and their types).
- 3.4 Digestive system in Aves and Mammals – Components and function; Dentition in mammals.
- 3.5 Respiratory system in vertebrates (Fishes to Mammals) – Gills, lungs and other respiratory structures.

UNIT IV – Functional Anatomy – II

15 Hrs

- 4.1 Excretory system in vertebrates (Fishes to Mammals) – Kidney and its structure; Modes of excretion.
- 4.2 Nervous system in vertebrates (Fishes to Mammals) – Brain, spinal cord and peripheral nerves.
- 4.3 Sense organs, simple receptors, organs of olfaction and taste, Lateral line system and electric organs
- 4.4 Evolutionary significance of internal fertilization; Placenta and its types.


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M.Sc. Zoology

PRACTICALS

- 1 Specimen studies - Salient characteristics, identification and classification of representative types of vertebrate groups - Pisces, Amphibia, Reptilia, Aves, and Mammalia.
- 2 Collection and preparation of slides of scales of fishes.
- 3 Dissections:
 1. Minor – a) Weberian ossicles of *Labeo*, and b) Respiratory trees of *Clarius*
 2. Major – a) Cranial nerves of *Labeo* (V, VII, IX & X cranial nerves)
- 4 Submission of assignment on: Submission of assignment [**To be submitted at the time of Practical Examination – 5 Marks**]

Suggested Books

- 1 Evolution of Vertebrates by E.H. Colbert
- 2 Evolutionary Biology by Mitkoff
- 3 Organic Evolution by Veer Bala Rastogi
- 4 Vertebrates – Comparative Anatomy, Function & Evolution (8th Ed.) by K.V. Kardong
- 5 Life of Vertebrates by J.Z. Young
- 6 A Textbook of Zoology Vol. II by Parker and Haswell (revised by Marshall)
- 7 Vertebrate Body by A.S. Romer
- 8 Chordates by Alexander
- 9 Comparative Vertebrate Anatomy by Hyman
- 10 Vertebrate Structure and Function by Waterman
- 11 Comparative Anatomy by Kent
- 12 Vertebrates by R.L. Kotpal
- 13 Chordate Zoology E. L. Jordan & P. S. Verma
- 14 Vertebrate Zoology & Evolution – Yadav B. N. & D. Kumar


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Semester – III
Core paper
Paper I – Endocrinology [EN]

UNIT I – Chemical and Neural Integration

15Hrs

- 1.1 Scope and position of endocrinology . Role of endocrines in health diseases
- 1.2 Concept of neurohumors and neurotransmitters.
- 1.3 Characteristics of neural and hormonal integration, neuro-endocrine mechanism.
- 1.4 Hormones as chemical messengers; Regulation of hormone secretions. Negative and Positive feedback mechanisms.
- 1.5 Concept of internal environment and homeostasis. Regulatory mechanisms.

15Hrs

UNIT II – Endocrine Glands and their Hormones

- 2.1 Invertebrate endocrine system – Hormones and their functions (Coelenterata and Annelida).
- 2.2 Invertebrate endocrine system – Hormones and their functions (Arthropoda and Echinodermata).
- 2.3 Hypothalamus and its secretions.
- 2.4 Vertebrate endocrine glands – Structure, hormones and functions of pituitary, thyroid, parathyroid and thymus.
- 2.5 Vertebrate endocrine glands – Structure, hormones and functions of adrenal, pancreas, pineal, gastro-intestinal tract and gonads.

UNIT III – Chemistry of Hormones and Mechanism of Hormone Action

15Hrs

- 3.1 Classification of hormones.
- 3.2 Biosynthesis of release and transport of amino acid derivatives.
- 3.3 Biosynthesis and transport of peptide and steroid hormones.
- 3.4 Membrane-bound and intracellular receptors.
- 3.5 Mechanism of action of amino acid derivatives, peptide and steroid hormones.

UNIT IV - Clinical and Applied Endocrinology

15Hrs

- 4.1 Obesity – Role of hormones and its metabolic complications – The role of Adipokines Insulin Resistance and Dyslipidemia.
- 4.2 Hormones in IVF, Pregnancy testing, and Amniocentesis.
- 4.3 Clinical disorders of male and female gonads.
- 4.4 Pheromones in applied endocrinology; Hypothalamo-pituitary disorders
- 4.5 Hormones in sericulture and Apiculture.


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PRACTICALS

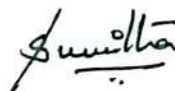
- 1 *In situ* demonstration of endocrine glands of the rat.
- 2 Histology slides of Endocrine glands - Pituitary, Thyroid, Parathyroid, Thymus, Adrenal, Pancreas, Ovary & Testis, and Uterus.
- 3 Effect of Eye Stalk ablation on Blood Glucose levels in Crabs.
- 4 Identification of Gonadotrophin in Human urine samples.
- 5 Effect of thyroxin and thiourea (antithyroid agent) on oxygen consumption in fish.
- 6 Effect of parathormone on serum calcium levels in Rat.
- 7 Effect of insulin and adrenalin on blood glucose levels in the Rat.
- 8 Submission of assignment on: [To be submitted at the time of Internal Examination - 5 Marks]

Suggested Books

- 1 Comparative Endocrinology of Invertebrates by Highman and Hill.
- 2 Comparative Vertebrate Endocrinology by P.J. Bentley, Cambridge Univ. Press.
- 3 General and Comparative Endocrinology by E.J.W. Barrington, Oxford Clarendon Press
- 4 Endocrinology Vol.1-3 by DeGroot L.J. et. al.
- 5 Text Book of Endocrine Physiology by C.R. Martin, Oxford Univ. Press, New York.
- 6 Text Book of Endocrinology by Turner and Bangnara (W.B. Saunders).
- 7 Vertebrate Endocrinology by McHadley.
- 8 Text Book of Comparative Endocrinology by Gorbman A, and Bern H.A., John Harley and Sous, New York.
- 9 Essential Endocrinology by Joen Laycock and Peter Loise Oxford Univ. Press.
- 10 A Text Book of Medical Physiology by Arthruma C. Guyton.
- 11 Text Book of Endocrinology by R.H. Williams (W. B. Saunders).


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Semester – III
Core paper
Paper II – Animal Behaviour

- UNIT I** **15Hrs**
- 1.1 Introduction to animal behaviour and brief history. Diversity and unity in the study of behaviour and complex behaviour.
 - 1.2 Development of behavior: Accommodative and Associate learning.
 - 1.3 Hormones and early development.
Concept of neurohumors and neurotransmitters.
 - 1.4 Neural control of behavior. Stereotyped behavior: Kinesis, taxis, orientation and reflexes.
- UNIT II** **15Hrs**
- 2.1 Motivation, decision making on different scales, drive, models of motivation, stress
 - 2.2 Conflict behavior: territorial conflicts, threat display, displacement activities and fighting as conflict behavior.
 - 2.3 Stimuli and communication: Diverse sensory capacities, sign stimuli, stimulus filtering. Communication. Hormones and behaviour: Chemical communication, body coloration,
 - 2.4 Application of pheromones and their biological actions in vertebrates and invertebrates
- UNIT III** **15Hrs**
- 3.1 Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator defenses.
 - 3.2 Aggression, homing, territoriality, dispersal. Host-parasite relations.
 - 3.3 Courtship and ritual behaviour: Mate selection, male-male selection, female choice and maternal behaviour.
 - 3.4 Genetic basis of behavior. Behavioural genetics: single and multiple gene effect.
- UNIT IV** **15Hrs**
- 4.1 Biological rhythms: Circadian and circannual rhythms.
 - 4.2 Origin of migration, types of migration, advantages of migration with suitable examples.
Migratory Behaviour Migration in fishes: Anadromous and catadromous migration
Migration in birds :
 - 4.3 Social organizations in insects (Termites and honey bees) and primates
 - 4.4 Hormone in insect & crustacean metamorphosis.


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Practical

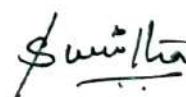
- 1) To study the geotaxis, phototaxis, chemotaxis and hydrotaxis in different animals
- 2) To study the response of woodlice to hygrostimuli.
- 3) Fixed action pattern in spider
- 4) Habituation in snail.
- 5) Foraging behaviour in local animals with suitable examples
- 6) Learning behaviour in animals
- 7) Selection of mate in different animal group
- 8) Observation of nesting behaviour in the birds
- 9) Observation of parental care in the animals as studied in the theory (pisces: Hippocampus, Arius, Amphibian: Ichthyophis, Birds: Myna, Jacana)
- 10) Observation of migratory in birds
- 11) Observation of courtship behaviour in birds (sparrows, fowl, Peacock, pigeon).
- 12) Submission of assignment on: **[To be submitted at the time of Internal Examination – 5 Marks]**

REFERENCE BOOKS:

1. Aubrey Manning and Marian. S. Dawkins. An Introduction to Animal Behaviour. Cambridge University Press, 1995.
2. McFarland. D. The Oxford Companion to Animal Behaviour.
3. McFarland.D. Animal Behaviour Psychology, Ethology and Evolution. Pitman Publications, 1985.
4. Slater.P.J.B. Essentials of Animal Behaviour. Cambridge University Press, 1999.
5. Krebs J.R and Davies, N.B. An Introduction to behavioural Ecology-III (Ed). Blackwell Science Ltd, 1993.


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SEMESTER – III

Elective - I

Paper III: Agricultural Entomology - I [AE -I]

UNIT I – Introduction

15 Hrs

- 1.1 Scope and Importance of Agricultural Entomology.
- 1.2 Insect – outline classification and emphasis on identification of phytophagous insects.
- 1.3 General Insect Plan - External Morphology, different types of mouthparts, Antenna Legs, Wings and External genitalia.
- 1.4 Insect development: growth, development and metamorphosis.
- 1.5 Insects and their environment. Habitat & Geographical distribution.

15 Hrs

UNIT II – Oilseed pest: Life history, hosts, nature of damage and control measures – I

- 2.1 *Aphis craccivora*, *Stomopteryx nertaria*.
- 2.2 *Agrotis segetum*, *Bemisia tabaci*.
- 2.3 *Athalia lugens*, *Lipaphis erysimi*.
- 2.4 *Asphondylia sesami*, *Eysarcoris ventralis*.
- 2.5 *Dichocrocis punctiferalis*, *Euproctis lunata*.

15 Hrs


UNIT III – Commercial crop pests: Life history, hosts, nature of damage and control measures – II

- 3.1 *Nilaparvata lugens*, *Nephotettix nigropictus*.
- 3.2 *Chrotogonus trachypterus*, *Atherigona naqvii*.
- 3.3 *Chilo partellus*, *Spodoptera frugiperda*.
- 3.4 *Sesamia inferens*, *Pyrilla perpusilla*.
- 3.5 *Helicoverpa armigera*, *Spodoptera litura*.

15 Hrs

UNIT IV – Vegetable & Stored Grains pests: Life history, hosts, nature of damage and control measures – III

- 4.1 *Urentius sentis*, *Plusia orichalcea*, *Dysdercus koenigii*, *Plutella xylostella*.
- 4.2 *Scirtothrips dorsalis*, *Euzophera perticella*, *Earias vittella*.
- 4.3 *Tanymecus indicus*, *Exelastis atmosa*, *Amsacta moorei*.
- 4.4 Major Stored Grain Pests - Khapra beetle, Rice weevil, Rice moth, Pulse beetle.
- 4.5 Minor Stored Grain Pests - Lesser grain borer, Indian meal moth, Saw-toothed beetle.


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M.Sc. Zoology

PRACTICALS

- 1 Collection, Preservation and identifications of insect pests of agricultural and stored products importance.
- 2 Study of permanent slides of different parts of insects.
- 3 Preparation of permanent slides of different parts of insects and their stages of the lifecycle.
- 4 Study of museum specimens of agricultural importance.
- 5 Rearing of pests of agricultural importance in the laboratory.
- 6 Dissection of the digestive system of Grasshopper or any suitable pest.
- 7 Dissection of the reproductive system of Grasshopper or any suitable pest.
- 8 Dissection of nervous systems of Grasshopper or any suitable pest.
- 9 Submission of assignment **[To be submitted at the time of Examination – 5 Marks]**

Suggested Books

- 1 Metcalf, C. L. & Flint, W.P: Destructive and useful insects. Their habits and control, 4th Edition, McGraw Hill, New York.
- 2 Pradhan. S. Insect pests of Crops. National Book Trust, New Delhi.
- 3 K. P. Srivastava: A Text Book of Applied Entomology Vol. I & II. Kalyani Publishers, New Delhi.
- 4 H. S. Pruthi: Text Book of Agricultural Entomology. ICAR Publication ., New Delhi.
- 5 Alwal, A. S. Agricultural Pests of India and South East Asia, Kalyani Publishers, New Delhi.
- 6 B. V. David & Kumara Swamy: Elements of Economic Entomology
- 7 Pedigo, L.P. Entomology and Pest Management. Prentice-Hall, New Delhi.


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Semester – III

Elective - I

Paper III - Medical Entomology – I [ME-I]

- UNIT I – Overview of Entomology** 15hrs
- 1.1 Significance of Insects to human importance: Reasons why insects are so successful.
 - 1.2 Classification of Insects, Arachnids and other medically important Arthropods.
 - 1.3 Insect Morphology: exoskeleton, head, thorax, and abdomen.
 - 1.4 Insects Physiology: digestive system, excretory system, respiratory system, circulatory system, nervous system, reproductive system, and endocrine system.
 - 1.5 Insect development: growth, development and metamorphosis.
- UNIT II – Biology and Life Cycles of Medically Important Insects, Ticks and Mites** 15hrs
- 2.1 Culicidae: Anophelinae (*Anopheles*), Culicinae (*Aedes* and *Culex*)
 - 2.2 Phlebotamidae: (Sandflies), Simuliidae: (Blackfly)
 - 2.3 Glossinidae: Tsetse fly
 - 2.4 Pulicidae: Fleas
 - 2.5 Acari: Ticks and Mites
- UNIT III – Insect Ecology & Behaviour** 15hrs
- 3.1 Scope of Insect ecology, ecological hierarchy, and influence of climate change on vector distribution.
 - 3.2 Insect population dynamics: Population fluctuations, and factors affecting population size.
 - 3.3 Community ecology: Classes of interaction, factors affecting interaction and consequences of interaction.
 - 3.4 Community structure - Species diversity, Species interaction.
 - 3.5 Insect behaviour – factors affecting dispersal behaviour, mating behaviour, reproductive and social behaviour.
- UNIT IV – Pathogens and Parasites Transmitted by Vectors, Venomous Arthropods** 15hrs
- 4.1 Bacteria- *Yersinia pestis*, Rickettsiae.
 - 4.2 Arboviruses – Flavivirus (DENV), (JEV), (TBEV) and Alphavirus (CHIKV).
 - 4.3 Protozoans – Plasmodium, Leishmania and Trypanosoma.
 - 4.4 Helminthes – *Wuchereria bancrofti* and *Onchocerca volvulus*.
 - 4.5 Venomous arthropods: Bees, Wasps, Ants, Spiders, Scorpions, Annoying insects, and Scabies.


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M.Sc. Zoology

PRACTICALS

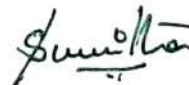
- 1 Insect collection and preservation of medically important insects.
- 2 Collection and identification of medically important insects, ticks, mites - up to genus level.
- 3 Collection and identification of venomous arthropods - up to genus level.
- 4 Identification of different mosquito breeding habitats.
- 5 Maintenance and study the stages of the life cycle of the mosquito.
- 6 Preparation of permanent mounts of mosquito larval mouthparts and respiratory siphon.
- 7 Preparation of permanent mounts of Insect leg and antennae.
- 8 Preparation of permanent mounts of wings of mosquito.
- 9 Preparation of permanent mounts of adult mosquito mouthparts.
- 10 Dissection of Mosquito salivary glands and Reproductive system.
- 11 Study of species diversity indices: Simpson's index, Shannon-Weiner index.
- 12 Study of permanent slides/specimens - *Plasmodium*, *Leishmania*, *Trypanosoma* and *Wuchereria*.
- 13 Maintenance of Insect / venomous arthropod collection box. Note: (**Submission of Insect / venomous arthropod collection box is must during the practical examination)
- 14 Submission of assignment [To be submitted at the time of Internal Examination – 5 Marks]

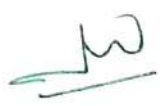
Suggested Books

- 1 Biology of Disease Vectors, 2nd Ed., William C. Marquardt, 2004, Elsevier Academic Press.
- 2 Medical and Veterinary Entomology, 2nd Ed., Gary Mullen & Lance Durden.
- 3 Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods - by Bruce Eldridge & John Edman.
- 4 Medical Toxicology by Richard C. Dart. Pub: Lippincott Williams & Wilkin.
- 5 Manual of Medical Entomology by Deane P. Furman & Paul Catts.
- 6 Infectious Diseases of Arthropods by Goddard.
- 7 Medical Entomology for Students 5th edition by Mike Service.
- 8 General and Applied Entomology by David and Ananthakrishnan.
- 9 Destructive and Useful Insects by R. L. Metcalf.
- 10 Ecology of Insects by Martin R. Speight Pub: Wiley-Blackwell.
- 11 Insect Ecology: An Ecosystem Approach - by Timothy D. Schowalter 3rd Edition. Pub: Elsevier, 2011.
- 12 Mosquito ecology field sampling methods 3rd edition by John B. Silver Pub: Springer.


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UNIT I – Morphology, Anatomy and Classification**15 Hrs**

- 1.1 An overview and classification of Monogenea, Aspidogastrea, Digenea and Cestoda.
- 1.2 Ultrastructure and function of the tegument.
- 1.3 Digestive system, feeding and mechanism of digestion.
- 1.4 Excretory system, paranephridial system and lymphatic system.
- 1.5 Nervous system and its mechanism; sense organs and its functions.

UNIT II – Reproduction, Ecology and Evolution**15 Hrs**


- 2.1 Reproductive system, eggshell formation, types of eggs, and morphology of larval forms.
- 2.2 Population concept, factors regulating population, dispersion concept.
- 2.3 Origin and evolution of Monogenea, Aspidogastrea, Digenea & Cestoda.
- 2.4 Helminth's host specificity and its breakdown.
- 2.5 Host-parasite interactions and their significance; the role of helminths as vectors of microbial infection

UNIT III – Trematode and Cestode Diseases**15 Hrs**

- 3.1 Trematode and Cestode parasites of humans; Morphology, life cycle, pathogenicity, diagnosis, treatment, and control measures of *Clonorchis sinensis*, *Fasciolopsis buski*, *Hymenolepis nana* and *Echinococcus granulosus*.
- 3.2 Helminthes of livestock with emphasis on *Fasciola hepatica* and *Moniezia* spp.
- 3.3 Life cycle and pathogenicity of Trematode parasites - *Dactylogyrus* spp. and *Gyrodactylus* spp.
- 3.4 Life cycle and pathogenicity of Cestode parasites - *Diplostomum* spp., *Sanguinicola inermis*.
- 3.5 General account of Trematode and Cestode parasites of wild animals with emphasis on *Dicrocoelium dendriticum* and *Echinococcus multilocularis*.

15 Hrs**UNIT IV – Adult Metabolism, Anthelmintics and Immunology**

- 4.1 Carbohydrate metabolism - Glycolysis (FMP-pathway), CO₂ fixation, PK/PEPCK branch point, malate dismutation; role of TCA cycle, Electron Transport chain - oxidation.
- 4.2 Protein composition and metabolism-Amino acid catabolism, transamination.
- 4.3 Lipid composition and metabolism-fatty acid metabolism and the role of β oxidation.
- 4.4 Immunity to schistosomiasis and fascioliasis; evasion of immunity and molecular mimicry.
- 4.5 Role of arthropods and molluscs in spreading of helminth diseases.


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M.Sc. Zoology

PRACTICALS

- 1 Collection, fixation, and staining techniques of permanent whole-mount preparations and identification of Monogeneans, Digeneans, Aspidogastreae and Cestode (Host Fishes, water snakes, birds, sheep, goat and cattle viscera).
- 2 *Fasciola* smear preparation, staining and study for eggs & concentration.
- 3 Collection and examination of infective larvae from intermediate hosts, snails, microcrustaceans (*Cyclops*, *Gammarus* etc., fishes).
- 4 Effect of light, and temperature on the emergence of cercaria.
- 5 Estimation of total proteins, carbohydrates and lipids in helminths.
- 6 Measurement of infection: Prevalence, density, intensity and index of helminth parasites.
- 7 Submission of assignment on: Classification of Monogenea, Aspidogastrea and Digenea; Classification of cestoda and trematode; Types of eggs and morphology of larval forms of cestode and trematode; Morphology and larval forms of cestode and trematode; Morphology and life cycle of *Fasciola hepatica*; Morphology and life cycle of *Echinococcus multiloculus*; Carbohydrate metabolism in helminths; Protein metabolism in helminths.

[To be submitted at the time of Examination – 5 Marks]

Suggested Books

- 1 Animal parasitology – J. D. Smyth (Cambridge Univ. Press., 1976).
- 2 Foundations of parasitology 6 ed. – L. S. Roberts & J. Janovy Jr (McGraw Hill Publ., 2000).
- 3 Parasitism – A. O. Bush, J.C. Fernandez & J. R. Seed (Cambridge Univ. Press, 2000).
- 4 Helminthology – Eds. N. Chaudhury & I. Tada (Narosa Publ. House, 1994).
- 5 Helminthes, Arthropods, & Protozoa of domesticated animals 6 ed. – E.J.L Soulsby (ELBS, 1976).
- 6 Introduction to parasitology – B.E. Matthews (Cambridge Univ. Press. 1998).
- 7 The physiology of Trematodes – J.D. Smyth & D. W. Halton (Cambridge Univ. Press, 1983).
- 8 The physiology and Biochemistry of Cestodes – J.D. Smyth & D.P. MEmanus, (Cambridge Univ. Press, 1989).
- 9 T.B.Fish Diseases – (Tr.) – D.A. Conroy & R.L. Herman (Narendra Publ. House, 1997).
- 10 Handbook of Medical Parasitology – V. Zaman & L. H. Keong (K.C. Ang Publishing Pvt. Ltd., 1989).
- 11 T.B. Medical parasitology – P. Chakraborty (New Central Book Agency, 2004).
- 12 Ecological Animal Parasitology – C. R. Kennedy (Black well Scientific Publ., 1975).
- 13 Infectious Diseases of fish – S. Egusa (Oxonian Pvt. Ltd., New Delhi, 1978).
- 14 A.T.B. of Parasitology 2 ed. – S. S. Kekar & R.S. Kelkar (Bombay popular Prakshan, 1993).

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New CBCS Syllabus for 2022-23 onwards

Paper III - Principles of Fisheries –I [PF-I]

UNIT I – Introduction to Fisheries

15 Hrs

- 1.1 History of fisheries; Present scenario of the fisheries sector in India; Blue revolution & food security.
- 1.2 Classification of fisheries; Resources of fisheries in India and Telangana in particular.
- 1.3 Fisheries institutes in India and their role in the augmentation of fish production.
- 1.4 Role of fisheries in the economic development of the nation.
- 1.5 Fishery economics - Basic concepts in economics; micro versus macro-economics.

UNIT II – Ecology of Water Bodies

15 Hrs

- 2.1 Ecology of lentic and lotic ecosystems. Aquatic pollution and its impact on fisheries.
- 2.2 Ecosystem and productivity – Energy flow, Trophodynamics, Ecological pyramids, Ecological productivity.
- 2.3 Water quality: Physico-chemical parameters of freshwater, brackish water and marine; Ideal conditions of soil and water for fish culture.
- 2.4 Population dynamics – Population characteristics, Dynamics of the fish population.
- 2.5 Reservoir, riverine and estuarine fisheries and their management.

UNIT III – Culture Systems


15 Hrs

- 3.1 Culture systems: open, closed, semi-intensive and intensive culture systems.
- 3.2 Poultry-cum-fish culture - Analysis of cost-benefit ratio.
- 3.3 Paddy and Horticulture-cum-fish culture - Analysis of cost-benefit ratio.
- 3.4 Sewage-fed fish culture - Opportunities and challenges.
- 3.5 Composite fish culture - Prawn-cum-fish culture.

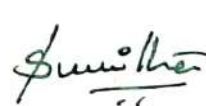
UNIT IV – Fish Harvesting Technology and Fish Biotechnology

15 Hrs

- 4.1 Types of Fishing Crafts – Non-mechanized and mechanized crafts.
- 4.2 Types Fishing Gears – Gear material, gear making, accessories.
- 4.3 Fish gear preservation methods and maintenance of crafts.
- 4.4 Cryopreservation of gametes; Fish genomics – chromosomal mapping.
- 4.5 Fish transgenics for therapeutics; Vaccine development for fish diseases.


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M.Sc. Zoology

PRACTICALS

- 1 Water analysis and its relation with Aquaculture – pH, Dissolved oxygen, Total alkalinity, Salinity, Calcium, Magnesium, Nitrates, Phosphates, total dissolved solids, Turbidity.
- 2 Collection and identification of planktons.
- 3 Collection and identification of benthos.
- 4 Identification of Fishing gear and craft models.
- 4 Karyotyping of chromosomes in fishes.
- 5 Submission of assignment **[To be submitted at the time of Examination – 5 Marks]**

Suggested Books

- 1 Water quality criteria for freshwater fish. Albastor, J. S. and Lloyd, R. Butterworth Scientific Pub.
- 2 Fish and Fisheries of India – Jhingran, V. G. Hindustan Publishing Corporation New Delhi.
- 3 The fishes of India – Francis. Day. Vol. I & II, New Delhi – CSIR.
- 4 The freshwater fishes of Indian Region – Jayaram, KC. Narendra Publishing house, New Delhi.
- 5 Prawns and prawn fisheries – Kurian, C.V. and Sebastian, V. O. Hindustan Publishing Corporation.
- 6 A manual of freshwater aquaculture – Santhanam, R. Sukllnaran. N. Natarajan Oxford and IBH Pub. comp.
- 7 Freshwater aquaculture – Rath, R. K. Scientific Publishers, Jodhpur.
- 8 Textbook of fish culture, breeding and cultivation of fish – MareelHuet, Fishing News Books.
- 9 Aquaculture development, processes and prospects – TVR Pillay Fishing news books.
- 10 Aquaculture – John, E. Bardach, John H. Ryther, W.O. Mclamey, John Willey and Sons, New York.
- 11 Fish Ecology – RJ. Wotton, Dalckie, Chapman and Hall, New York.
- 12 Environmental stress and fish diseases – Wedemeye, G. A. Narendra. Publishing House.
- 13 Diseases of fishes – C. Vandujn, Narendra Publishing House, New Delhi.
- 14 Aquaculture Principles and Practices by T. V. R. Pillay.





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UNIT I – Cellular Neurobiology

15 Hrs

- 1.1 Ultrastructure of a neuron, axonal transport and its mechanism.
- 1.2 Types of neuronal and glial cells, organization of neurons in the brain.
- 1.3 Organization of CNS and PNS.
- 1.4 Overview of the functional anatomy of the brain and spinal cord.
- 1.5 Neuroanatomical and neuroimaging technique.

UNIT II – Neurophysiology

15 Hrs

- 2.1 Principles and methods of electrophysiological techniques – voltage and patch-clamp.
- 2.2 Ion channels and ion pumps.
- 2.3 Types of biopotentials and mechanism; Action potential and propagation cable conduction.
- 2.4 Synaptic transmission, molecular and physiological mechanisms, EPSP and IPSP.
- 2.5 Synaptic receptor – nicotinic and muscarinic Ach receptor.

UNIT III – Molecular Neurobiology


15 Hrs

- 3.1 Neurotransmitters and neuromodulators.
- 3.2 Metabolism and functional significance of neurotransmitters, specific transmitter defined system.
- 3.3 G-protein coupled receptor mechanisms.
- 3.4 Neuroendocrine circuits.
- 3.5 Neuroimmune circuits.

15 Hrs

UNIT IV – Cognitive and Behavior Neurobiology

- 4.1 Biorhythm – Sleep and awake; neuronal – humoral mechanisms.
- 4.2 Types of learning and memory; cellular and molecular basis of learning and memory; the role of hippocampus and LTP in memory.
- 4.3 Neuronal basis of feeding.
- 4.4 Neuronal basis of emotion.
- 4.5 Cerebral cortex; organization and behaviour.


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M.Sc. Zoology

PRACTICALS (All experiments involving live animals are for demonstration only)

- 1 Demonstration of gross anatomical regions of the brain.
- 2 Isolation of hippocampus, preparation of AchE, staining, the protocol of hippocampal cell culture.
- 3 Identification of different types of neural and glial cells.
- 4 Estimation of acetylcholine in different regions of the brain.
- 5 Estimation of acetylcholinesterase sodium and potassium ATPase activity.
- 6 Electrophysiological demonstration of biopotentials and conduction velocity.
- 7 Determination of maze learning and estimation of proteins in the hippocampus.
- 8 Biochemical differentiation of fast and slow muscles – SDH, LDH activities.
- 9 Induction of stress and estimation of glycogen, lactate, AchE and Na-K ATPase activities.
- 10 Submission of assignment **To be submitted at the time of Examination – 5 Marks]**

Suggested Books

- 1 Physiology and biophysics – Ruch and Patten.
- 2 A textbook of muscle physiology – D. A. Jones and J. M. Round.
- 3 Neurobiology – Gordon M Shepperd.
- 4 Principles of neural science – E. Kandel and others.
- 5 Essentials of neural science and behaviour – E. Kandel and others.
- 6 Behavioural neuroscience – Cottman.
- 7 From Neuron to Brain – Nichollas, J. G. others.
- 8 Neuroscience – A. Longstaff .
- 9 Elements of Molecular Neurobiology – C U M Smith.
- 10 Physiology of excitable cells – D. J. Aidley.
- 11 Textbook of medical physiology – Guyton.


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Semester – III
Elective - I

Paper III - Comparative Animal Physiology – I [CAP-I]

- UNIT I – Comparative Aspects of Digestion and Nutrition** 15 Hrs
- 1.1 Scope, principles and validity of comparative approach to physiology.
 - 1.2 Origin of nutritive types - special dietary requirements of some animals, amino acid requirements, and essential vitamins.
 - 1.3 Mechanisms of food intake and feeding mechanisms, comparative physiology of digestive enzymes and regulatory mechanism of digestion.
 - 1.4 Coordination of digestive activities - Visceral autonomic system and gastrointestinal hormones.
 - 1.5 Comparative aspects of carbohydrate pathways - Glycolysis and gluconeogenesis pathways and regulation.
- UNIT II – Comparative Aspects of Respiration** 15 Hrs
- 2.1 Availability of oxygen, uptake of oxygen and factors that influence uptake.
 - 2.2 Oxygen consumption by an intact animal, modifying agents.
 - 2.3 Adaptations to diving and high altitudes.
 - 2.4 Comparative aspects of the transport of oxygen and carbon dioxide; regulation of respiration.
 - 2.5 Respiratory pigments in different phylogenic groups, genes with reference to haemoglobin.
- UNIT III – Osmoregulation, Excretion and Thermoregulation** 15 Hrs
- 3.1 Problem of osmoregulation and biological responses in different environments.
 - 3.2 Comparative aspect of osmoregulation in different animal groups.
 - 3.3 Excretory organs and general mechanisms of excretion in various animal groups.
 - 3.4 Freezing, winter hardening, lethal limits and resistance adaptation; Behavioral and locomotory adaptations; Heat regulation - physical and chemical.
 - 3.5 Temperature regulation in homeotherms; neural mechanism of thermoregulation.
- UNIT IV – Deranged Metabolism and Disorders** 15 Hrs
- 4.1 Effects of colonic bacterial flora (beneficial and harmful effect); lactose intolerance, GERD.
 - 4.2 Liver cirrhosis and its causative agents; fatty liver.
 - 4.3 Chronic obstructive pulmonary disease – Asthma, sleep apnea, and snoring.
 - 4.4 Electrolyte imbalance - Acidosis, alkalosis; Dialysis.
 - 4.5 Heatstroke; thirst and its physiological mechanism.

M.Sc. Zoology

PRACTICALS

- 1 Estimation of levels of lactic acid and free amino acids levels.
- 2 Effect of Heterosmotic media on blood chlorides in any one animal-crustacean/fish.
- 3 Effect of acclimatization to hetero osmotic media on SDH, LDH in gills and muscle tissue of crustacean/fish.
- 4 Effect of starvation on glycogen levels in fish/crab.
- 5 Effect of starvation on free amino acids in the liver and muscles of fish/crab.
- 6 Starvation induced changes in aminotransferases in fish/crab.
- 7 Starvation induced changes in excretory products in fish.
- 8 Acclimatization to cold and high temp in fish/crab and its effect on oxygen consumption.
- 9 Effect of the thyroid and antithyroid agents on oxygen consumption in fish.
- 10 Submission of assignment [To be submitted at the time of Examination – 5 Marks]

Suggested Books

- 1 Comp. Animal Physiology by Ladd Prosser (Publ. W. B. Saunders, Philadelphia)
- 2 Comp. Animal Physiology by William Hoar. (Pub. E.E.E. IBH).
- 3 Animal Physiology – Adaptation and function By F. Reed Hainswoth (Publ. by Addison – Wesley Publ. Company, California).
- 4 Animal Physiology by Kent Schmidt Nielson (Publ. E.E.E. IBH).
- 5 Animal Physiology and adaptation by David Gordon.
- 6 Animal Physiology by Wilson.
- 7 Concise Medical physiology by Sujit K. Chaudari.
- 8 Textbook of medical physiology by Arthur Guyton


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Semester – IV
Elative-II
Paper IV: Fish Biology [FB]

15Hrs

UNIT I – Introduction and Diversity of Fishes

- 1.1 Introduction, general characteristics, evolutionary succession and fossil history of fishes.
- 1.2 The early evolution of fishes; Chondrichthyans fishes - Sharks, Skates and Rays.
- 1.3 Characterization and classification of: Ostracoderms, Placoderms, Acanthodians, Holocephali, and Elasmobranchs.
- 1.4 Characterization and classification of Cyclostomes, Sarcopterygii, Dipnoi, and Actinopterygii.
- 1.5 Integumentary system - Basic structure of the skin, dermal and epidermal pigments, fins, and scales.

15Hrs

UNIT II – Fishes – Habits and Habitats

- 2.1 Buoyancy – Dynamic lift and static lift; swim bladder- structure and function.
- 2.2 Locomotion – Myotomal muscles and caudal fin oscillation mechanisms.
- 2.3 Feeding mechanisms – Food habits and feeding, fish as predators and prey; Food chains and food webs.
- 2.4 Osmoregulation and ion balance – Freshwater, brackish water and marine teleosts; kidney and salt balance.
- 2.5 Fish migration, migratory mechanisms, mating, and parental care.

15Hrs

UNIT III – Fish Biology


- 3.1 Skeletal system - skull, splanchnocranium, jaw suspension and vertebral column.
- 3.2 Digestive system – Digestive tract, enzymes and digestion.
- 3.3 Respiratory mechanism – Respiratory gills and lungs.
- 3.4 Circulatory system – Heart and accessory pumps.
- 3.5 Excretory system – Excretory organs and excretion.

15Hrs

UNIT IV – Fish Biology and Embryogenesis

- 4.1 Nervous system- Central nervous system, brain and peripheral nervous system.
- 4.2 Sense organs – Olfactory, taste buds, touch receptors, photoreceptors, lateral line and internal ear.
- 4.3 Endocrine system – Pituitary gland, neurohypophysis, adrenal gland, gonads, and thyroid gland.
- 4.4 Reproductive system – Male and female reproductive organs; Role of hormones.
- 4.5 Embryogenesis - Early development and post-embryonic development.


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New CBCS Syllabus for 2022-23 onwards






M.Sc. Zoology

PRACTICALS



- 1 Morphometric identification of fishes.
- 2 Meristic characters of fishes.
- 3 Dissection and preparation of permanent slides of scales.
- 4 Isolation of pituitary gland.
- 5 Identification of fish developmental stages - egg, spawn, fry, fingerling and adult.
- 6 Dissection of Weberian ossicles.
- 7 Dissection of the digestive system.
- 8 Dissection of the reproductive system.
- 9 Sexual differentiation of fishes.
- 10 Determination of chlorides in heterosmotic media.
- 11 Submission of assignment on: Digestive system; Respiratory system; Circulatory system; Excretory system; Nervous system; Endocrine system; Reproductive system; Osmoregulation system
[To be submitted at the time of Examination – 5 Marks]

Suggested Books

- 1 Textbook of Fish Biology & Indian Fisheries Rahul P Parihar
- 2 A Text-Book of Fish Biology and Fisheries by S S Khanna and H R Singh,
- 3 Handbook of Fish Biology and Fisheries,(Vol I & II) by Paul J. B. Hart and John D. Reynolds
- 4 Fish Biology by, C B L Srivastava.
- 5 Fauna of British India, including Ceylon & Burma – by Francis Day.
- 6 Indian Fishes and Fisheries – Jhingran.
- 7 Introduction to Fish Physiology – Dr. Lynwood S. Smith
- 8 An Introduction to fishes – S. S. Khanna
- 9 Ichthyology – K.F. Lagler, John F., Bardach, R. R. Miller and D. R. May Passino


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Semester – III

Elective - II

Paper IV – Sericulture [SER]

- UNIT I – Introduction** **15Hrs**
- 1.1 Introduction - Sericulture as an agro-industry.
 - 1.2 Mulberry cultivation - Varieties of mulberry and non-mulberry food plants; Agroclimatic conditions for Moriculture; Agricultural practices; Harvesting and Preservation of leaves.
 - 1.3 Diseases of Mulberry and their management - Bacterial diseases, Viral diseases, Fungal diseases.
 - 1.4 Mineral deficiency diseases and their management.
 - 1.5 Insect Pests of Mulberry and their management.
- UNIT II – Biology of Silk Worms** **15Hrs**
- 2.1 Races of mulberry and non-mulberry silkworms.
 - 2.2 External morphology of *Bombyx mori* - Egg, larva, pupa & adult.
 - 2.3 Internal morphology of *Bombyx mori* - Digestive, respiratory, nervous, excretory and reproductive systems.
 - 2.4 Morphology and anatomy of silk glands.
 - 2.5 Properties and composition of silk.
- UNIT III – Silkworm Rearing** **15 Hrs**
- 3.1 Rearing house and rearing appliances.
 - 3.2 Environmental conditions for silkworm rearing.
 - 3.3 Rearing of early stages (Chawki rearing) and late stages of silkworms.
 - 3.4 Mounting and harvesting of silkworm cocoons.
 - 3.5 Silkworm diseases and pests.
- UNIT IV – Harvesting Technology** **15Hrs**
- 4.1 Transport of cocoons to the cocoon markets.
 - 4.2 Commercial characters of cocoons, defective cocoons and price fixation.
 - 4.3 Reeling technology – Mulberry and Vanya silk rearing.
 - 4.4 Seed technology – Grainage & DFLs; By-Products: Types and uses.
 - 4.5 Role of biotechnology in sericulture.


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M.Sc. Zoology

PRACTICALS

- 1 Rearing appliances.
- 2 Study of the life history of silkworm by rearing.
- 3 Identification of different types of silkworms - Mulberry, Tasar, Eri and Muga.
- 4 Identification of defective cocoons.
- 5 Sex differentiation of larva, pupa and adult silkworms.
- 6 Preparation of permanent slides of mouth parts, spiracles and appendages of the larva.
- 7 Dissection of silk glands of the silkworm larva.
- 8 Dissection of digestive and nervous systems in the larva.
- 9 Dissection of reproductive organs in the adults moths.
- 10 Calculation of Shell Ratio.
- 11 Visit to the Cocoon market.
- 12 Visit to the Reeling Centre and Grainage Units.
- 13 Submission of assignment on [To be submitted at the time of Internal Examination – 5 Marks]

Suggested Books

- 1 FAO Manuals
- 2 Ullal and Narasimhanna: Hand Book of Practical Sericulture
- 3 Manjeet Singh Jolly: Appropriate Sericulture Techniques
- 4 CSB Bulletins of Sericulture
- 5 Ganga and Sulochana Shetty: An Introduction to Sericulture
- 6 NCERT Manuals of Sericulture


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M.Sc. Zoology Semester – III
Elective - II
Paper IV - Applied Toxicology [AT]

UNIT I – Principles of Toxicology

15 Hrs

- 1.1 Definition, scope and importance of toxicology; classification of toxic agents - natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins.
- 1.2 Dose, dose-effect and dose-response relationship – Acute toxicity, chronic toxicity; toxic kinetics.
- 1.3 Factors affecting toxicity - species and strains, age, sex, nutritional status, hormone, environmental factors.
- 1.4 Absorption and distribution of toxicants, portals of entry – Skin, gastrointestinal tract and respiratory system.
- 1.5 Bio-accumulation, bio-magnification, biotransformation and elimination of xenobiotics.

UNIT II – Biochemical toxicology

15 Hrs

- 2.1 Mechanism and reactions of toxicants - Covalent bonding, non-covalent bonding and enzymatic reactions.
- 2.2 Lipid peroxidation – Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS); Mechanism of Reactive Oxygen Species production; Superoxide, hydrogen peroxide and hydroxyl radicals in toxicity of xenobiotics.
- 2.3 Oxidative Stress – Consequences of oxidative stress; protein and DNA damage.
- 2.4 Antioxidant defense mechanism – Role of glutathione, superoxide dismutase, metallothionein.
- 2.5 Xenobiotic induced intracellular and cellular alterations.

UNIT III – Systemic toxicology

15 Hrs

- 3.1 Basics of organ toxicity - Target organs, organ selectivity and specificity.
- 3.2 Hepatotoxicity - susceptibility of the liver; Types of liver injury and biochemical mechanism.
- 3.3 Pulmonary toxicity – Lung injury, systematic lung toxins, lung pathology.
- 3.4 Renal toxicity – susceptibility of the kidney to toxicants; Chemical induced renal injury.
- 3.5 Neurotoxicity – Effect of toxic agents on neurons, ion channel neurotoxins; Lesions of neural tissue.

UNIT IV – Environmental and Occupational Toxicology

15 Hrs

- 4.1 Eco-toxicology of heavy metals – Mechanism of heavy metal toxicity; Case studies of Arsenic, Mercury and Cadmium.
- 4.2 Environmental problems by organochlorine and organophosphate pesticides; case studies of DDT, endosulfan, parathion and malathion.
- 4.3 Occupational hazards - physical, chemical, biological and mechanical hazards. Occupational diseases: Pneumoconiosis, silicosis, asbestosis; Prevention of occupational diseases.
- 4.4 Carcinogenesis – Carcinogen types, mechanisms of carcinogenesis; Skin cancer, lung cancer and leukaemia.
- 4.5 Legislation and Regulation – Federal government, State government; Legislation and regulation in other countries.

New CBCS Syllabus for 2022-23 onwards

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M.Sc. Zoology

PRACTICALS (All experiments involving live animals are for demonstration only)

- 1 Determination of LC50/LD50 of selected toxicant (bioassay method).
- 2 Determination of LPO activity by TBRAS method.
- 3 Effect of toxicant on glycogen, glucose and amino acids.
- 4 Hepato-toxicant effect on Total Bilirubin Content (direct and indirect method).
- 5 Estimation of SGOT and SGPT as a marker enzyme for hepatotoxicity.
- 6 Estimation of serum creatinine activity as a marker enzyme for Renal toxicity.
- 7 Micronuclei test.
- 8 Estimation of Hemoglobin and RBC in Lead exposed experimental animals.
- 9 Estimation of AchE activity as a marker of pesticide poisoning.
- 10 Industrial visit
- 11 Submission of assignment on [To be submitted at the time of Examination – 5 Marks]

Suggested Books

- 1 Principles of ecotoxicology- 3rd edition 2006, C H Walker, S P Hopkin, R N Sibly and D B Peakall (Eds.), Taylor and Francis, New York, NY.
- 2 Introduction to Environmental toxicology -3rd edition 2003, W.G. Landis and M.H. Yu. Lewis publishers.
- 3 Text Book of Modern Toxicology 2000 edition, Ernst Hodgson and Patrica Levi, McGraw – Hill Int. ed.
- 4 Principles of toxicology 2010 edition, Anju Agarwal and Krishna Gopal, IBDC Publishers India.
- 5 Essentials of Toxicology 2011 edition, Vijay Kumar Matham, New India Publishing Agency, New Delhi, India.
- 6 Principles of Biochemical Toxicology- Jatimbrell; Taylor and Francis Ltd, London.
- 7 Basic Environmental Toxicology – Lorris G. Cockerham, Barbara S Shane; CRC Press, London.
- 8 Handbook of Toxicology – Thomas J Haley, Willan O Berndt; Hemisphere Publishing cooperation.
- 9 Modern Toxicology (3 Volumes) - P K Gupta and Salunkha; B V Gupta Metropolitan Book Co., Ptv Ltd.
- 10 Encyclopedia of Toxicology – O P Jasra.


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Semester – IV

Core Paper

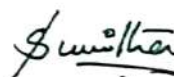
Paper I: Animal Biotechnology [AB]

- UNIT I – Introduction and Animal Improvement** 15Hrs
- 1.1 Introduction to biotechnology- scope, importance and its applications.
 - 1.2 Mammalian reproductive systems and gametogenesis.
 - 1.3 *In vitro* fertilization and embryo transfer; ICSI, sperm sexing.
 - 1.4 Cryopreservation, cryoprotection and gamete banking.
 - 1.5 Biotechnology in the improvement of livestock herds and breeding selected traits.
- UNIT II – *In vitro* Culture of Cells and Tissues** 15Hrs
- 2.1 Cell culture - Equipment and materials for cell culture technology, the principle of sterile techniques and cell propagation, primary and established cell line cultures.
 - 2.2 Mammalian cell lines & their characteristics.
 - 2.3 Basic techniques of mammalian cell culture *in vitro*, disaggregating of tissue and primary culture, maintenance of cell culture, cell separation.
 - 2.4 Tissue culture system – cell tissue fragment, organ and embryo cultures, merits and demerits.
 - 2.5 Scaling-up of animal cell culture, cell synchronization, cell cloning, micromanipulation, cell transformation.
- UNIT III – Production of Recombinant Organisms and Transgenic Animals** 15Hrs
- 3.1 Cloning of mammals.
 - 3.2 Transgenic animals; creation of transgenic mice, retroviral vector method, Microinjection, embryonic stem cell method – short gun, electroporation, lipofection, microinjection.
 - 3.3 Production of other transgenic animals – cattle, sheep, pigs and fish.
 - 3.4 Large scale culture and production from genetically engineered animal cell culture.
 - 3.5 Large scale culture and production from recombinant microorganisms –Downstream processing.
- UNIT IV – Application of Biotechnology** 15Hrs
- 4.1 Medical biotechnology – Application of RFLP in forensic science, hybridoma technology and production monoclonal antibodies.
 - 4.2 Environmental Biotechnology - Bioassay, biosensors in ecotoxicological screening; Bioleaching of metals by microorganisms; Bioabsorption of metals by bacteria.
 - 4.3 Insecticide development – biopesticides; *Bacillus thuringiensis* – mode of action of toxin, toxin gene isolation and engineering of *B. thuringiensis*.
 - 4.4 Biotechnology of aquaculture - sex reversal in fish and sterile fish culture.
 - 4.5 Use of animals as bioreactors; Knock out model systems and their utility.



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M.Sc. Zoology

PRACTICALS

- 1 Preparation of culture media: a) Bacteria and/or b) animal cells.
- 2 Methods of cultivating a) Bacteria and/or b) animal cells.
- 3 Isolation and characterization of microbes useful in fermentation.
- 4 Staining Techniques for microbes:
a) Gram's staining; b) Spore & Capsule staining;
c) Acid-fast stain; d) Fungal stains
- 5 Determination of microbial growth curve.
- 6 Antibiotic sensitivity test.
- 7 Yield estimation in fermentations products:
a) *Aspergillus niger*-citric acid; b) *Lactobacillus* – Lactic acid from curd; and
c) *Saccharomyces cerevisiae* (Yeast) Alcohol
- 8 Microbial evaluation of stored foods from plant/animal origin for contaminants/toxins.
- 9 Visit to Quality Control Labs.
- 10 Submission of assignment [To be submitted at the time of Internal Examination – 5 Marks]

Suggested Books

- 1 Culture of Animal Cells. R. Ian Freshney, Wiley Liss.
- 2 Animal Cell culture – Practical Approach – Ed. John R W Masters, Oxford.
- 3 Animal Cell Biotechnology, 1990 – Speir, RE and Griffith, JB, Academic Press.
- 4 Molecular Biotechnology – Glick & Pasternock.
- 5 Gene manipulation – Old & Primrose.
- 6 Biotechnology – S. Mitra.





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Semester – IV
Core paper
Paper IV–Biodiversity

UNIT I – introduction to Biodiversity

15 Hrs

- 1.1 Biodiversity: Concepts, Definition. Values of biodiversity: Consumptive use and Productive use ; Social, Ethical, Aesthetic, Option & Environment service values.
- 1.2 Genetic diversity: Nature and origin of genetic variations; Measurement of genetic Diversity.
- 1.3 Species diversity: History and origin of species diversity; Species diversity indices ; Measures of diversity – Alpha, Beta & Gamma diversity.
- 1.4 Ecosystem diversity: Classification and nature of ecosystems (in brief); Ecosystem diversity of India (in brief), Agro- biodiversity: Origin and evolution of cultivated species diversity; Vavilovian centers ; Diversity in domesticated animal species.

UNIT II – Status of biodiversity

15 Hrs

- 2.1 Biodiversity at global, national and local levels.
- 2.2 Hot spots of biodiversity; India as a mega diversity nation. Endemism and endemic species.
- 2.3 Threats to biodiversity: Deforestation & habitat destruction, Hunting & Overexploitation; Introduction of exotic species, Pollution. Endangered, Vulnerable, Rare and Threatened species..
- 2.4 Conservation of Biodiversity: Objectives and action plans; Strategies – In-situ and Ex- situ conservation; Peoples movement, Role of educational Institutions and NGO's, Biodiversity Awareness programmes
- 2.5 Biodiversity and Biotechnology: Role of Biotechnology in: Assessment of biodiversity and bioresources.

UNIT III – Biodiversity and law

15 Hrs

- 3.1 Biodiversity legislation: Legal aspects with special reference to India; CITES; Trade related Intellectual Property Rights..
- 3.2 Biodiversity conventions: Earth Summit and other conventions; Convention on Biological Diversity.
- 3.3 Biodiversity conservation; Utilization of Biodiversity/Bioresources. GMO's and their impact on biodiversity.
- 3.4 legislations of Indian Biodiversity laws or acts
- 3.5

15 Hrs

UNIT IV – Biodiversity Management:

- 4.1 Organizations associated with biodiversity management – IUCN, UNEP, UNESCO, WWF, FAD,WCMC–their role and contributions.
- 4.2 Bioprospecting; Biopiracy; Biosafety.
- 4.3 Intellectual property rights and patents.
- 4.4 Future strategies for biodiversity conservation in India.
- 4.5 Success stories of conservation of faunal biodiversity in india

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M.Sc. Zoology

Practical

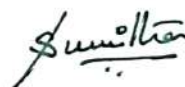
1. Study the faunal diversity of state and country, provide relevant information
2. Prepare a report on conservation projects of biodiversity or wild life fauna in India
3. Prepare report on Biosphere reserves in India
4. Prepare a report on national parks and sanctuaries in India with reference to the biodiversity
5. Prepare report on endanger, rare, vulnerable animals of India
6. Determination of species diversity by Shannon-Weiner Index
7. Determination of species diversity by Simpson's index
8. Critical studies on endangered, endemic, vulnerable, exotic species of India.
9. Field visits will be integral part of the Practical. Visits to nearby Zoo, Forest, seashore, Nursery, Aquaria or a wildlife sanctuary, Natural history Museum and any other relevant site must be arranged. submission of a report
10. Submission of assignment on: [To be submitted at the time of Internal Examination – 5 Marks]

REFERENCE BOOKS:

1. Dasmann. F Raymond. Wildlife Biology. Wiley Eastern Ltd. India. 1982.
2. Encyclopedia of Nature and Science. Vols 1-18. Bay Books Pvt.Ltd. Sydney, 1974.
3. Burnie. D. (Ed). Animal: the Definitive Visual Guide to the Worlds Wildlife. D.K.Publications, 2001.
4. B.B.Hosetti, 2005: Glimpses in Biodiversity, Daya Publishing House, Delhi.
5. B.B.Hosetti, 2008: concepts in wildlife management, Daya Publishing House, Delhi.
6. K.C.Agrwal, 2006. Concepts in biodiversity, Narendra Publishers Meerut
7. B.B.Hosetti, 2008: Wild life management in India, Pointer Publishers, Jaipur ,


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Semester – IV

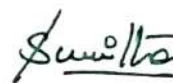
Elective - I

Paper III – Agricultural Entomology – II [AE – II]

- UNIT I – Introduction** **15 Hrs**
- 1.1 Introduction – Antiquity of pest problem.
 - 1.2 Reasons for insects turning into pest, reasons for pest outbreaks.
 - 1.3 Economic injury level; Economic threshold level.
 - 1.4 Climatic factors and natural barriers.
 - 1.5 Pest monitoring and methods of survey.
- UNIT II – Insect Pest Control Methods – I** **15 Hrs**
- 2.1 IPM - Definition, necessity of IPM; Tools of IPM.
 - 2.2 Cultural control methods.
 - 2.3 Physical control and Mechanical control methods.
 - 2.4 Biological control methods.
 - 2.5 Genetic control methods.
- UNIT III – Insect Pest Control Methods – II** **15 Hrs**
- 3.1 Chemical control – Inorganic pesticides, Organic pesticides, Organochlorides, Organophosphates, Carbamates.
 - 3.2 Synthetic pyrethroids – Classification and their applications.
 - 3.3 Synergists, Repellents, Baits, Toxicants, Antifeedants, Attractants, Chemosterilants.
 - 3.4 Pesticide formulations – Dust, Sprays, Emulsions, Aerosols, Fumigants, Seed dressers or Seed treatment chemicals etc.
 - 3.5 Pesticide application methods and Safety parameters in pesticides application.
- UNIT IV – Pesticide Resistance and Advances in IPM** **15 Hrs**
- 4.1 Chitin Synthesis Inhibitors; Insect growth regulators; Pheromones.
 - 4.2 Pesticide resistance – Definition and types of resistance; Mechanism of resistance.
 - 4.3 Regulatory methods – Insecticides and Plant Quarantine Acts.
 - 4.4 Modern trends in pesticide research; Biotechnological advances in IPM.
 - 4.5 Pesticide applications and their adverse consequences on environment; Concepts of organic farming.


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M.Sc. Zoology

PRACTICALS

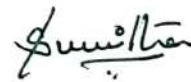
- 1 Collection, Identification and Preservation of insect pests of agricultural, medical and veterinary importance.
- 2 Usage of light traps for insect collection.
- 3 Usage of pheromone traps for insect collection.
- 4 Bird perches and their utility.
- 5 Bioassay of insecticides using different methods of exposure.
- 6 Calculation of LD50 using probit analysis.
- 7 Study of antifeedant activity in *Spodoptera* or any suitable pest.
- 8 Culturing of NPV.
- 9 Visit to **ICRISAT** Hyderabad and any other institution/agriculture fields/centers of Telangana State.
- 10 Submission of assignment **To be submitted at the time of internal Examination – 5 Marks]**

Suggested Books

- 1 Introduction to General and Applied Entomology by V.B. Awasthi.
- 2 Integrated pest management principles and practices by Abrol D.P, CABI publications.
- 3 Integrated pest management principles and applications vol. 1 by Singh, CBS publication.
- 4 Applied Entomology by P.G. Fenemore and Alka Prakash.
- 5 Biodiversity and insect pests management S. Ignacimuthu, S. Jayaraj.
- 6 Integrated pest management principles and applications Amerika Singh, O.P.Sharma, D.K. Garg.
- 7 Handbook of Integrated pest management by ICAR.
- 8 Pest management principles and practices by Rajesh Ravi.
- 9 Theory and practices of Integrated pest management by A.K. Dhawan & Ramesh Arora.
- 10 A textbook of Applied Entomology, Vol. I & II. by K.P. Srivastava.


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Semester – IV

Elective - I

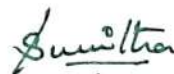
Paper III: Medical Entomology – II [ME - II]

- UNIT I – Introduction to Vector Control** 15Hrs
- 1.1 Scope and importance of Medical entomology.
 - 1.2 Role of research organizations in medical entomology – CDC, WHO, VCRC, CRME, NIMR, NCDC.
 - 1.3 Trajectory of National level vector control programmes - NMCP, NMEP, NFCP and NVBDCP.
 - 1.4 Source reduction, environmental modification and manipulation and solid waste management.
 - 1.5 Community awareness programmes for vector control.
- UNIT II – Physical, Mechanical & Personal Protective Measures** 15Hrs
- 2.1 Making houses and shelters insect-proof, insecticide-treated screening and curtains.
 - 2.2 Impregnation, protective clothing, treating fabrics with an insecticide, LLINs.
 - 2.3 Repellents - Vaporizers, Dispensers, Coils, DEET, etc.
 - 2.4 Avoidance and diversion of biting Dipterans.
 - 2.5 Recent advances in vector management, GIS and remote sensing in vector control.
- UNIT III – Bio-pesticides and Growth Regulators** 15Hrs
- 3.1 *Bacillus thuringiensis*, *Lagenidium giganteum*, *Romanomermis iyengari* as vector control bio agents.
 - 3.2 Plant extracts as potential mosquito larvicides.
 - 3.3 Nanoparticles: Synthesis of plant-mediated silver nanoparticles for vector control.
 - 3.4 Sterile Insect Technology (SIT).
 - 3.5 Genetically Modified Organisms (GMO); Releasing of Insects carrying a Dominant Lethal gene (RIDL).
- UNIT IV – Chemical Control and Insecticide Resistance** 15Hrs
- 4.1 History of insecticide discovery, classification of Insecticides.
 - 4.2 Synthetic insecticides and their mode of action: Organochlorides, Organophosphates, Carbamates.
 - 4.3 Pyrethrins and Pyrethroids, classification of pyrethroids and mode of action.
 - 4.4 Pesticide application methods and safety precautions.
 - 4.5 Insecticide bioassay, Pesticide resistance - types and mechanisms.



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M.Sc. Zoology

PRACTICALS

- 1 Collection of indoor / outdoor resting mosquitoes and preparing a voucher specimen.
- 2 Assessment mosquito larval density in breeding habitat.
- 3 Estimation of predatory efficiency against mosquito larvae.
- 4 Extraction of phytochemicals for larvicidal activity- Alkaloid test.
- 5 Estimation of mosquito man-hour density.
- 6 Estimation of gonotrophic cycle duration.
- 7 Assessment of repellent activity.
- 8 Determination of larval susceptibility to different insecticides.
- 9 Synthesis of silver nanoparticles and their efficacy as larvicides.
- 10 Surveillance and report writing on the breeding habitat of mosquitoes.
- 11 Submission of assignments **[To be submitted at the time of Examination – 5 Marks]**

Suggested Books

- 1 Handbook for integrated vector management, WHO/HTM/NTD/VEM/2012.3
- 2 Biology of Disease Vectors, 2nd Ed., William C. Marquardt, 2004, Elsevier Academic Press.
- 3 Medical Toxicology by Richard C. Dart. Pub: Lippincott Williams & Wilkin.
- 4 Manual of Medical Entomology by Deane P. Furman & Paul Catts.
- 5 Hand Book of Medical Entomology by K N Panicker, Geme Urge Dori
- 6 Medical Entomology for the Students 5th edition by Mike Service.
- 7 Destructive and Useful Insects by R. L. Metcalf.
- 8 Mosquitoes and their control 2nd edition by Norbert Becker pub: Springer.
- 9 Mosquito ecology field sampling methods 3rd edition by John B. Silver Pub: Springer.
- 10 Vector Control Methods for use by individuals and communities by Jan A. Rozendaal Pub: WHO 1997.
- 11 Global strategic framework for integrated vector management. Geneva: World Health Organization; 2004 (WHO/CDS/CPE/PVC/2004.10).
- 12 Phytochemical Reference standard of selected medicinal plants, ICMR -2012
- 13 Chemical pesticides, mode of action and toxicology by CRC, Press, London. By Jorgen Stenersen (2004).
- 14 Pesticides preparation and mode of action. John Wiley and Sons, Ltd., New York. By Cremlyn R. (1979).
- 15 Pesticides application: Principles and practices. Clarendon Press. Oxford. - Haskell P. T. (1985).
- 16 The standard pesticides user's guide. 5th edition, Prentice Hall Inc. By Bert L. Bolimont. (2000).
- 17 The chemistry of pesticides. The Macmiller Press Ltd., Hong Kong by Kenneth A. Hassall (1982).
- 18 Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases By Graham Matthews Pub: Wiley-Blackwell 2011.


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UNIT I – Protozoology

15Hrs

- 1.1 Protozoan ecology, nutrition; population structure and kinetics.
- 1.2 Metabolic pathways in protozoa – carbohydrate, protein and lipids.
- 1.3 Antimetabolites analogues, inhibitors and transport phenomenon in protozoa.
- 1.4 Enzyme secretions and activity; nucleic acids composition and its synthesis.
- 1.5 Respiration in protozoa; nutritional requirements and nitrogen excretion.

UNIT II – General Account and Taxonomy of Nematodes

15Hrs

- 2.1 History, scope and significance of nematodes.
- 2.2 Classification of nematodes up to family level with examples.
- 2.3 Functional anatomy – Structure of cuticle and cuticular modifications, Body wall, musculature and pseudocoelom.
- 2.4 Digestive system with special reference to oesophageal modifications and associated glands.
- 2.5 Excretory system, nervous system and sense organs of nematodes.

UNIT III – Morphology, Development, Life Cycles and Pathology

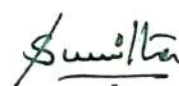
15Hrs

- 3.1 Reproductive system, types of eggs, embryology and development.
- 3.2 Life cycles, pathology, treatment of the gastrointestinal nematodes; tissue nematodes, epidemiology and geographical distributions of i) *Strongyloides stercoralis*, ii) *Ancylostoma duodenale*, iii) *Dracunculus medinensis*, iv) *Wuchereria bancrofti*, v) *Brugia malayi* and vi) *Trichinella spiralis*; Visceral larva migrans, dermatitis and pulmonary bronchitis.
- 3.3 Origin and evolution of animal nematode parasites and host interaction.
- 3.4 General account of entomophilic Nematodes – characteristics and classification.
- 3.5 General account of phytonematodes; Life history and pathology of *Hirschmanniella* and *Meloidogyne*.

UNIT IV – Acanthocephala

15Hrs

- 4.1 Medical Acanthocephalans - General account, morphology, life cycle, clinical symptom, pathogenicity, diagnosis, prophylaxis and treatment of the diseases caused by *Macracanthorhynchus hirudinaceus* and *Moniliformis*.
- 4.2 The role of vectors in spreading of diseases in humans.
- 4.3 Host-parasite relationships and their immunological reactions.
- 4.4 Innate and acquired immune resistance.
- 4.5 Antihelminthic drug action and drug resistance.



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New CBCS Syllabus for 2022-23 onwards


M.Sc. Zoology


PRACTICALS


- 1 Collection of nematode parasites and acanthocephalan parasites, fixation, preparation of permanent slides and their identification.
- 2 Hosts – cockroaches (invertebrate), fish (carps & catfishes), birds (fowl), and mammals (sheep and cattle).
- 3 Identification of nematode eggs and larval stages.
- 4 Blood smear preparation for the identification of *Plasmodium* spp.
- 5 Qualitative and quantitative estimation of carbohydrates, proteins and lipids in normal, infected tissues and parasites.
- 6 Ecology of parasites and biostatistical calculations of incidence, intensity, density and index of infection of nematode parasites.
- 7 Submission of assignment [To be submitted at the time of Examination – 5 Marks]


Suggested Books

- 1 Principles of nematology – by Chitwood B.G. and Chitwood M.B.
- 2 Nematode parasites of domestic animals and of man – by Levine Norman D Burgess publishing Co.
- 3 The natural history of Nematodes by Pionar G.O., Prentice-Hall, New Jersey.
- 4 The organization of nematodes by Croll N.A., Academic press.
- 5 The physiology of nematodes by Lee D. L. & At. Kinson, Columbia University Press, New York.
- 6 Agricultural Helminthology – Filipjev I. N.
- 7 General Parasitology by Cheng T.C.
- 8 Introduction to animal parasitology by J. D. Smith.
- 9 Entomophilic nematodes and their role as biological control of pest insects by George Poiner, Pub. INC Engle wood Cliffs, New Jersey.
- 10 Parasitology by Noble & Noble.
- 11 Parasitology by K. D. Chatterjee.
- 12 Parasitology by Chandler.
- 13 Human Helminthology - by Faust.
- 14 Medical Zoology by Sobti.


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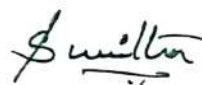


Paper III: Principles of Fisheries - II [PF-II]

- UNIT I – Introduction to Aquaculture** **15Hrs**
- 1.1 Definition, history, present status and future prospects of aquaculture.
 - 1.2 Criteria for selection of fish species for culture.
 - 1.3 Advanced techniques in seed production - Induced breeding methods in Fishes and Prawns.
 - 1.4 Types of hatcheries: construction and management of hatcheries, and seed transportation methods.
 - 1.5 Fishermen Cooperative societies – structures and functions.
- UNIT II – Biology of Cultivable Fishes, Prawns and Crabs** **15Hrs**
- 2.1 India Major carps – *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*.
 - 2.2 Exotic Major carps – *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella* and *Cyprinus carpio*.
 - 2.3 Air-breathing fishes - *Channa punctatus*, *Channa marulius*, *Clarias batrachus*.
 - 2.4 Cultivable prawns – *Macrobrachium rosenbergii*, *Macrobrachium malcolmsonii*.
 - 2.5 Cultivable crabs - *Barytelphusa cunicularis*.
- UNIT III – Fish Pond Management** **15Hrs**
- 3.1 Site selection, design and construction of Aquafarms.
 - 3.2 Pre-stocking pond management – Aquatic weeds, predatory insects and their control.
 - 3.3 Nursery pond management – pond fertilization.
 - 3.4 Stocking and Rearing pond Management, Natural fish food organisms, supplementary feeding.
 - 3.5 Brood pond Management – Monosex culture.
- UNIT IV – Disease Management & Post-harvest Technology** **15Hrs**
- 4.1 Infectious diseases of fishes, their prevention and control measures.
 - 4.2 Infectious diseases of prawns, their prevention and control measures.
 - 4.3 Non-infectious diseases of fishes and their preventive measures.
 - 4.4 Processing and preservation of fishes and prawns.
 - 4.5 By-products and value added-byproducts of fishes and prawns.


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M.Sc. Zoology

PRACTICAL

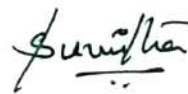
- 1 Identification of fishes through general characters and morphometry and meristic characters.
- 2 Identification of prawns through general characters and morphometry.
- 3 Identification of fish and prawn through developmental stages.
- 4 Symptomatic identification of diseased fishes and prawns.
- 5 Analysis and identification of planktons – Phytoplanktons and Zooplanktons.
- 6 Identification of benthos as fish feed.
- 7 Separation of pituitary gland from fish.
- 8 Demonstration of induced breeding technology in common carp.
- 9 Submission of assignment **[To be submitted at the time of Examination – 5 Marks]**

Suggested Books

- 1 Water quality criteria for freshwater fish. Albastor, J. S. and Lloyd, R. Butterworth Scientific. London.
- 2 Fish and Fisheries of India – Jhingran, V. G. Hindustan Publishing Corporation New Delhi.
- 3 The fishes of India – Francis. Day. Vol. I & II New Delhi – CSIR.
- 4 The freshwater fishes of Indian Region – Jayaram, KC. Narendra Publishing house, New Delhi.
- 5 Prawns and prawn fisheries – Kurian, C.V. and Sebastian, V. O. Hindustan Publishing Corporation.
- 6 A manual of freshwater aquaculture – Santhanam, R. Sukllnaran. N. Natarajan Oxford and IBH Pub. Comp.
- 7 Freshwater aquaculture – Rath, R. K. Scientific Publishers, Jodhpur.
- 8 Textbook of fish culture, breeding and cultivation of fish – Mareel Huet, Fishing News Books.
- 9 Aquaculture – John, E. Bardach, John H. Ryther, W.O. Mclamey, John Willey and Sons, New York.
- 10 Fish Ecology – RJ. Wotton, Dalckie, Chapman and Hall, New York.
- 11 Prevention and control of fish & prawn diseases, 2nd edition. By K. P. Biswas
- 12 Diseases of fishes – C. Vandujn, Narendra Publishing House, New Delhi.
- 13 Aquaculture Principles and Practices by T. V. R. Pillay
- 14 A textbook of fish, fisheries and technology by K. P. Biswas.
- 15 Fisheries and Aquaculture by Ravishankar Piska.


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Semester – IV

Elective - I

Paper III: Neuroscience - II [NS-II]

UNIT I – Sensory System **15Hrs**

- 1.1 Types of receptors, basic mechanisms of sensory transduction; sensory circuit and sensory pathways.
- 1.2 Neurobiology of chemoreception – taste and smell.
- 1.3 Neurobiology of somatic sense.
- 1.4 Neurophysiology of hearing.
- 1.5 Neurophysiology of vision.

UNIT II – Sensory and Motor System **15Hrs**


- 2.1 Pain and its mechanism - Physiological and neurohumoral.
- 2.2 Muscle sense – receptors, muscle spindle and GTO.
- 2.3 Neurobiology of Autonomic function; Motor hierarchies.
- 2.4 Reflex, reflex pathways and coordination of reflexes.
- 2.5 Mechanism of locomotion and movement.

UNIT III – Developmental Neurobiology **15Hrs**

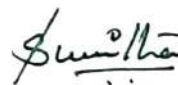
- 3.1 Induction and patterning of nervous system.
- 3.2 Generation and survival of nerve cells, neurotrophic factors.
- 3.3 Guidance of axons to their targets, synaptogenesis and developmental plasticity.
- 3.4 Neural connection and their reactions to injury.
- 3.5 Regeneration, reinnervation, sprouting; neural specificity; Remodeling of neural circuitry.

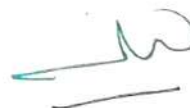
UNIT IV – Applied Neurobiology **15Hrs**

- 4.1 Concept of stress; physiological basis of stress and its disorders.
- 4.2 Role of muscles in sports, slow and fast muscles in exercise and its metabolism.
- 4.3 Diseases of motor units - neuropathies and myopathies.
- 4.4 Neuronal disorders – Parkinson's, Alzheimer's, psychosomatic disorders.
- 4.5 Behavioral disorders, drug abuse and dependence.


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M.Sc. Zoology

PRACTICALS (All experiments involving live animals are for demonstration only)

- 1 Tail flick test for measurement of pain.
- 2 Spinal reflexes in decerebrated animal.
- 3 Preparation of neuromuscular system for electrophysiological recording.
- 4 Biochemical differentiation of fast and slow muscles – SDH, LDH activities, glycogen and lactate content in altered neurobiological conditions.
- 5 Effect of ankle sprain on muscle metabolism.
- 6 Determination of contractile properties of muscle in pathological condition.
- 7 Determination of conduction velocity in nerve.
- 8 Induction of stress and estimation of on glycogen, lactate, AChE and Na-K ATPase activities.
- 9 Experimental studies on atrophy, hypertrophy of muscles and nerve degeneration as well as regeneration.
- 10 Rotarod test for motor coordination.
- 11 Submission of assignment [To be submitted at the time of internal Examination – 5 Marks]

Suggested Books

- 1 Physiology and biophysics – Ruch and Patten
- 2 A text book of muscle physiology – D. A. Jones and J. M. Round
- 3 Neurobiology – Gordon M Shepperd
- 4 Principles of neural science – E. Kandel and others
- 5 Essentials of neural science and behaviour – E. Kandel and others
- 6 Behavioral neuroscience – Cottman
- 7 From Neuron to Brain – Nichollas, J. G. others
- 8 Neuroscience – A. Longstaff
- 9 Elements of Molecular Neurobiology – C U M Smith
- 10 Physiology of excitable cells – D. J. Aidley
- 11 Textbook of Medical Physiology – Guyton


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Paper III: Comparative Animal Physiology - II [CAP-II]

UNIT I – Responses of Animals to Their Environment 15Hrs

- 1.1 General receptor characteristics, receptor potentials and sensory coding.
- 1.2 Adaptations in organ systems for reception – Chemo-, thermo-, mechano-, and electro- receptors.
- 1.3 Central nervous system - Insect to vertebrate comparison.
- 1.4 Integration for effective behavior - spinal reflex; Learning and memory and its genetic basis.
- 1.5 Stress biology and related disorders.

UNIT II – Effectors and Responses 15Hrs


- 2.1 Gland effectors for secretion - mechanism of target tissue activation and mechanism of secretion.
- 2.2 Types of muscle fibers slow, fast and asynchronous flight muscle.
- 2.3 Mechanism and chemistry of muscle fiber contraction.
- 2.4 Accessory movements – skeletal levers, elastic movements.
- 2.5 Effectors for movement – Cyclosis, amoeboid, ciliary, flagellar movements, and control of movement.

UNIT III – Circulation of Body Fluids 15Hrs

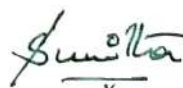
- 3.1 Major types of body fluids – fluid compartments.
- 3.2 Classification of circulatory mechanisms.
- 3.3 Types of vertebrate hearts, heart rate, regulation and cardiac output, chemical and nervous control of heart rate.
- 3.4 Invertebrate hearts – annelids, scorpion, insect, crustacean, molluscan, and tunicate hearts.
- 3.5 Regulation of vertebrate circulatory systems.

UNIT IV – Control of Reproduction & Adaptations to Environment 15Hrs

- 4.1 *r*-selected and *k*-selected reproductive patterns; timing with respect to environmental variables, photo periods.
- 4.2 Hormonal control of insect growth and reproduction.
- 4.3 Hormones and development; sexual behaviour in vertebrates; pregnancy and parental care.
- 4.4 Influence of environmental factors on chromatophore systems.
- 4.5 Biological rhythms circadian - circumlunar and circannual rhythm.


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PRACTICALS (All experiments involving live animals are for demonstration only)

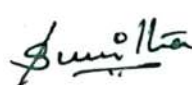
- 1 Maze behaviour studies in rat.
- 2 Metabolic distinction of slow and fast muscles.
- 3 Kymographic studies of muscle properties.
- 4 Effect of temperature on heart beat of crab.
- 5 Effect of AchE and adrenaline on heartbeat in crab.
- 6 Effect of estrogen on serum calcium levels of rat.
- 7 Pregnancy testing by using HCG kit.
- 8 Dissection of nervous system of cockroach and crab, and their comparison.
- 9 Dissection of male and female reproductive systems of cockroach and crab, and their comparison.
- 10 Submission of assignment **[To be submitted at the time of Examination – 5 Marks]**

Suggested Books

- 1 Comp. Animal Physiology by Ladd Prosser (Publ. W. B. Saunders, Philadelphia).
- 2 Comp. Animal Physiology by William Hoar, (Pub. E.E.E. IBH).
- 3 Animal Physiology – Adaptation and function., By F. Reed Hainsworth (Publ. by Addison-Wesley Publ. company, California).
- 4 Animal Physiology by Kent Schmidt Nielson (Publ. E.E.E. IBH).
- 5 Animal Physiology and adaptation by David Gordon.
- 6 Animal Physiology by Wilson.


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Semester – IV
Project

Each student has to execute independent project work under the guidance of the teacher in their respective college.


The process of execution of the project will be supervised by the concerned teacher from initiation to final submission.

Credits and marks distribution for Project (Zoo_404pr)

	Credits	Marks
Internal Assessment		
Research Design	1	25
Completion Seminar	1	25
Semester-end Assessment		
Research work (Semester end test)	1	25
Dissertation, Final presentation & Viva	3	75
Total	6	150

Note:

The project offered in Semester IV carries 6 credits worth 150 marks.


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