



**Rayat Shikshan Sanstha's**  
**Sadguru Gadage Maharaj College, Karad.**  
**(An Autonomous)**

**SYLLABUS**

For

**M.Sc. Zoology**  
**(Semester Pattern)**  
**M. Sc. Sem. I to II**



**Estd. 1954**

**'A+' Accredited by NAAC (2017)**  
**with CGPA 3.63**

As per the  
National Education Policy 2020  
(NEP2020)

To be implemented  
from  
**June, 2023 onwards**

### M.Sc. Programme Structure of Zoology Part – I (CBCS pattern) (2023-2024)

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		Research Methodology 4 credits	Open elective OJT/FP	Research project	Cumulative credits	Degree
			Mandatory 14 credits	Electives 4 credits					
First	6.0	Sem I	<b>MJ-MZT23-101</b> Molecular Cell Biology 4 credits <b>MJ-MZT23-102</b> Applied Entomology 4 credits <b>MJ-MZP23-105</b> Practical I 4 credits (based on MJ-MZT23-101 and MJ- MZT23-102) <b>MJ-MZP23-106</b> Practical II 2 credits (Based on GE-MZT23-103)	<b>GE-MZT23-103</b> Cell Biology <b>GE-MZT23-103</b> Animal Physiology <b>GE-MZT23-103</b> Entomology <b>GE-MZT23-103</b> Aquaculture and Fisheries <b>GE-MZT23-103</b> Sericulture	<b>RM-MZT23-104</b> Research Methodology 4 credits	--	--	22	PG Diploma
		Sem II	<b>MJ-MZT23-201</b> Physiological Chemistry 4 credits <b>MJ-MZT23-202</b> Anatomy and Physiology 4 credits <b>MJ-MZP23-205</b> Practical III 4 credits (based on MJ-MZT23-201 and MJ- MZT23-202) <b>MJ-MZP23-206</b> Practical IV 2 credits (Based on MJ-MZT23-203)	<b>GE-MZT23-203</b> Cell Biology <b>GE-MZT23-203</b> Animal Physiology <b>GE-MZT23-203</b> Entomology <b>GE-MZT23-203</b> Aquaculture and Fisheries <b>GE-MZT23-203</b> Sericulture	--	<b>FP-MZT23-204</b> Field Project 4 credits	--	22	
Cumulative credits for PG Diploma			28	8	4	4	-	44	Exit Option

**Abbreviations:** Yr: Year, Sem: Semester, MT: Mandatory Theory, MP: Mandatory Practical, E: Elective, OJT: On Job Training, FP: Field Project

<b>SEMESTER-I (Duration- Six Month)</b>											
	Sr. No.	Course Code	Theory and Practical			College Assessment (SEE)			Internal Assessment (CCE)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
<b>NEP 2020</b>	1	MJ-MZT23-101	4	4	4	80	32	3	20	8	30 min
	2	MJ-MZT23-102	4	4	4	80	32	3	20	8	30 min
	3	GE-MZT23-103	4	4	4	80	32	3	20	8	30 min
	4	RM-MZT23-104	4	4	4	80	32	3	20	8	30 min
	5	MJ-MZP23-105	-	8	4	100	40	3	-	-	-
	6	MJ-MZP23-106	-	4	2	50	20	3	-	-	-
<b>TOTAL (A)</b>			--	28	22	470	--	--	80	--	--
<b>SEMESTER-II (Duration- Six Month)</b>											
	1	MJ-MZT23-201	4	4	4	80	32	3	20	8	30 min
	2	MJ-MZT23-202	4	4	4	80	32	3	20	8	30 min
	3	GE-MZT23-203	4	4	4	80	32	3	20	8	30 min
	4	MJ-MZP23-205	-	8	4	100	32	3	-	-	-
	5	MJ-MZP23-206	-	4	2	50	32	3	-	-	-
	6	FP-MZT23-204	-	-	4	100	32	3	-	-	-
<b>TOTAL (B)</b>			--	--	22	490	--	--	60	--	--
<b>TOTAL (A+B)</b>			--	--	44	970	--	--	140	--	--

<ul style="list-style-type: none"> <li>• Student contact hours per week: 28 Hours (min.)</li> </ul>	<ul style="list-style-type: none"> <li>• Total Marks for M. Sc. - I : <b>1100</b></li> </ul>
<ul style="list-style-type: none"> <li>• Theory and practical lectures: 60 minutes Each</li> </ul>	<ul style="list-style-type: none"> <li>• Total credits for M. Sc. - I (Semester I &amp; II): <b>44</b></li> </ul>
<ul style="list-style-type: none"> <li>• MJ: Major</li> <li>• GE: General Elective</li> <li>• MZT: Zoology Theory</li> <li>• MZP: Zoology Practical</li> <li>• FP: Field Project</li> </ul>	<ul style="list-style-type: none"> <li>• Practical Examination is at the end of each semester.</li> <li>• SEE: Semester End Exam</li> <li>• CCE: Continues Comprehensive Exam</li> <li>• <b><i>Separate passing is mandatory for Theory, Internal and Practical Examination</i></b></li> </ul>

**M.Sc. Programme Structure of Zoology  
Part – I (CBCS pattern) (2022-2023)**

<b>Sr. No.</b>	<b>Course Code</b>	<b>Course Title</b>		<b>Credits</b>
<b>SEMESTER - I</b>				
1	MJ-MZT23-101	Paper I	Molecular Cell Biology	4
2	MJ-MZT23-102	Paper II	Applied Entomology	4
3	GE-MZT23-103	Paper III	<b>Any one of the following Elective papers</b> <ul style="list-style-type: none"> <li>• Cell Biology</li> <li>• Animal Physiology</li> <li>• Basic Entomology</li> <li>• Fisheries Resources: Inland and Marine Fisheries</li> <li>• General Sericulture and Mulberry cultivation</li> </ul>	4
4	RM-MZT23-104	Paper IV	Research Methodology	4
5	MJ-MZP23-105	Practical I	Based on MJ-MZT23-101 and MJ-MZT23-102	4
6	MJ-MZP23-106	Practical II	Based on GE-MZT23-103	2
<b>SEMESTER - II</b>				
7	MJ-MZT23-201	Paper V	Physiological Chemistry	4
8	MJ-MZT23-202	Paper VI	Anatomy and Physiology	4
9	GE-MZT23-203	Paper VII	<b>Any one of the following Elective papers</b> <ul style="list-style-type: none"> <li>• Cell Biology</li> <li>• Animal Physiology</li> <li>• Basic Entomology</li> <li>• Fisheries Resources: Inland and Marine Fisheries</li> <li>• General Sericulture and Mulberry cultivation</li> </ul>	4
10	FP-MZT23-204	Paper VIII	Field Project	4
11	MJ-MZP23-205	Practical III	Based on MJ-MZT23-201 and MJ-MZT23-202	4
12	MJ-MZP23-206	Practical IV	Based on GE-MZT23-203	2
			<b>Total Credits</b>	<b>44</b>
<b>Theory and Practical examinations will be Semester wise.</b>				

Rayat Shikshan Sanstha's  
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**(An Autonomous College)**  
**Department of Zoology**  
**M.Sc. Part I**  
**Programme Specific Outcomes (PSOs)**

**After studying the course, the student will be able to**

1. understand the concepts of the principles in cell and molecular biology.
2. understand the eusocial insects; insect pests and various control measures as well as sericulture techniques.
3. understand the physiology of muscle, sense organs, Reproduction, and mammalian developmental physiology.
4. understand the research methodology; various techniques include centrifugation, chromatography, electrophoresis, microscope, and immunological techniques.
5. understand the concepts and principles of biosystematics and biostatistics.
6. understand the principle of physiological chemistry; the chemical foundation of biology, carbohydrate, lipid, and protein metabolism, nucleic acid structure, and synthesis.
7. know the principles of animal physiology.
8. understand environmental physiology, exercise physiology, Ergonomic and industrial physiology, and occupational physiology
9. complete the field project during summer vacations.

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M.Sc. Part I  
**Course Outcomes (COs)**

1. Course presents structural and functional aspects of cell and cell organelles.
2. Students will understand the secretory pathway.
3. Students will know the cell cycle and cell signaling.
4. Students will understand the detailed structure of the chromosome
5. Students will understand the biological composition of cell
6. Students will understand the various crop pests, household pests, forest pest, cloth pests, etc., and damage and control measures.
7. Students will understand the applied aspects of entomology.
8. Students will understand the nutritional significance of insects.
9. This course includes basics in Taxonomy, and Biodiversity of animals, plants and microbes.
10. Students will get to know the diversity of animals and plants.
11. Students will be able to do the classification of animals.
12. Students will know the importance of biodiversity in the life of human being.
13. Students will get to know the various methods of conservation of nature.
14. Students will understand the various diseases related to metabolism of carbohydrates, proteins, & lipids
15. Students will understand biostatistics methods like student 't' tests & ANOVA test etc.
16. Students will understand the various instruments & their working mechanism.
17. Students will understand the methods like TLC, Electrophoresis, HPLC
18. Students will understand the physiology of entire systems of the body.
19. Students will understand the idea of the metabolic process of various food components like proteins, carbohydrates, lipids etc.
20. Students will understand the functions of heart, working mechanism of the circulatory system.
21. Students will understand the endocrine system & the diseases related with the endocrine system.
22. Students will understand the functional mechanism of every system of the body.

**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Paper I**  
**MJ-MZT23-101: Molecular Cell Biology**  
**4 credits**

**Unit I: The Interphase Nucleus, Chromatin, and the Chromosome (15 Hrs.)**

The ultrastructure of interphase nucleus, nuclear envelope, and nuclear pore complex, Nuclear import and export, Nucleolus. The DNA structure, Histone proteins, Packaging of DNA into chromatin. Euchromatin and Heterochromatin, The C-value paradox, Fine structure and classification of chromosomes.

**Unit II: Membrane transport, protein sorting and vesicular trafficking (15 Hrs.)**

Biomembrane structure and functions, Transport of Ions and Small Molecules across the membranetranscellular transport, Cell-cell junctions and their significance Protein sorting and vesicular trafficking

**Unit III: Cellular Respiration and Degradation (15 Hrs.)**

**Mitochondria:** Biogenesis, membrane differences, structure, and functions.

**Lysosomes:** Origin, structural polymorphism and functions

**Peroxisomes:** Biogenesis, ultrastructure and functions.

**Endosomes:** Late and early endosomes, assembly structure, and functions

**Proteasomes:** Types, assembly structure and functions.

**Unit IV: Cytoskeleton, Cell signalling and Cell division (15 Hrs.)**

**Cytoskeletal elements:** microtubules, microfilaments, intermediate filaments and associated motor proteins

**Cell signalling:** Features of signal transduction, Molecular Mechanisms of Signal Transduction, Gated Ion Channels, Receptor Enzymes, G Protein-Coupled Receptors and Second Messengers, Regulation of Transcription by Steroid Hormones, Signalling by Mechanoreceptors, pain receptors, Taste receptors and olfactory receptors.

**Cell Division:** Cell cycle regulation, cyclin dependent kinases and check point pathways, Extracellular and Intracellular Cues Regulating Entry into Meiosis.

**Reference books:**

1. Molecular biology of the Cell –Bruce Alberts
2. Molecular Cell biology – Lodish
3. The cell: A molecular approach - Cooper
3. Molecular cell biology – Gerald carp

**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Paper II**  
**MJ-MZT23-102 Applied Entomology**  
**4 credits**

**Unit I:** (15 Hrs.)

1. **Study of generalized insect:** Grasshopper (Morphology and Anatomy, brief Account).
2. **Types of Insect pests:** Definition with suitable examples.
3. **Types of Forest pests:** Defoliators, Sapsuckers, Borers of trees, spike disease of Sandal, Soil insects damaging forest trees, control methods of forest pests.

**Unit II:** (15 Hrs.)

1. **Stored grain pests:** Rice weevil, Rice moth, Khapra beetle, Pulse beetle, Rust red floorbeetle, Angoumois grain moth.
2. **Veterinary entomology:** Farm animal pests- Horse fly, Blowfly, Stable fly, Louse fly, Warble fly, Screw worm, Cattle louse, bird louse, Flea

**Unit III:** (15 Hrs.)

**Sericulture:** History of Sericulture, Life cycles of Mulberry and Non-mulberry Silkworms, Rearing technology of mulberry silkworm, Diseases and pests of Mulberry silkworm, Moriculture and cultural practices, Diseases and pests of Mulberry.

**Unit IV:** (15 Hrs.)

1. **Apiculture:** The honey bees, Social organization of honey bees, Life history of honey bees, Methods of bee keeping.
2. **Lac culture:** Lac insect- Taxonomy, distribution and life history, Host plants and lac insects, Strains of lac insect and their propagation, Cultivation practices, Lac extraction and uses.
3. **Forensic entomology:** History, Corpse associated arthropod classes, Role of arthropods in forensic entomology, Examples.
4. **Nutritional entomology:** Advantages of eating insects (Entomophagy), Examples of insects generally consumed, Nutritional value, Entomophagy as a source of income.

**Suggested Readings:**

1. A text book of Applied Entomology, vol.2 - K. P. Srivastava, 1996.
2. Modern Entomology. D. B. Tembhare 2013.
3. Sericulture and Pest Management – T.V. Sathe and A.D. Jadhav, 2001.
4. Introduction to General and applied entomology. V. B. Awasthi. 2017
5. Agricultural Pests of India and South East Asia – A.S. Atwal, 1993.
6. Beekeeping in the tropics – G.S. Smith, 1960.
7. Beekeeping in India, ICAR, New Delhi, S. Singh, 1975.
8. Lac culture in India farm information unit, DEMOFA, New Delhi, S. Krishnaswami,
9. Elements of Entomology- Rajendrasingh. 2004



**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Cell Biology**  
**Elective paper GE-MZT23-103 Molecular biology of the gene**  
**4 credits**

**Unit - I: Molecular Genetic Technique** (15 Hrs.)

1. Chromosome as a carrier of genes
2. Linkage groups, genetics maps, crossing over and genetic recombinations
3. Genetic recombinations analysis in *Drosophilla*
4. Hybridization techniques –Southern blotting, Northern blotting, In situ hybridization, DNA microarray

**Unit - II: Genes, Genomics and Chromosome.** (15 Hrs.)

1. Simple sequence DNA – satellite DNA
2. Transposable DNA elements
  - a) DNA Transposones
  - b) LTR Retrotransposones
  - c) Non LTR Retrotransposons (SINES and LINES)
3. Organelles DNA
  - a) Mitochondrial DNA
  - b) Chloroplast DNA
4. Genomics- Genome wide Analysis of Gene Structure and Expression
5. Morphology and Functional Elements of Eukaryotic Chromosomes
  - a) Chromosome number, size and shape at metaphase
  - b) Banding patterns
  - c) Chromosome painting and DNA sequencing

**Unit - III:** (15 Hrs.)

**1. Gene and its expression:**

- a) Concept of gene
- b) Transcriptional control of gene expression in prokaryote (Lac, trp - operon).

**2. Transcriptional control of gene expression in eukaryotes:**

- a) RNA polymerases and gene control.
- b) Regulatory sequences in protein coding gene.
  - c) Activators & Repressors of Transcription.
- d) Regulation of transcription factor activity.
  - e) Regulation of elongation and termination of transcription.
- f) Other eukaryotic transcription systems.

**3. Post transcriptional gene control and nuclear transport:**

- a) Processing of pre m-RNA.
- b) Regulation of pre m-RNA processing.
- c) Macromolecular transport across the nuclear envelope.
- d) Cytoplasmic mechanisms of post transcriptional control.

**Unit - IV: Genetic engineering** (15 Hrs.)

- a) Recombinant DNA technology
- b) Selection, screening and analysis of recombinants
- c) Knockout gene technique
- d) Production of transgenic mice
- e) CRISPR-Cas9 based genome editing

**Suggested Reading Material:**

1. Genes by Benjamin Lewin.
2. Molecular Biology of the gene by Watson
3. An introduction to genetic engineering By Desmond S.T. Nicholl

**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Animal Physiology**  
**Elective paper GE-MZT23-103 Animal Physiology**  
**4 credits**

<b>Unit - I: Membrane and Neuromuscular physiology</b>	<b>15 Hrs.</b>
Membrane Physiology and its potential. Anatomy of nervous system – Neuroglia and neurons. Physiology of nerve fiber its excitation and conduction. Anatomy and physiology of skeletal, cardiac and smooth muscle Neuromuscular junction- physiology and transmission.	
<b>Unit - II: Physiology of Sense organs</b>	<b>15 Hrs.</b>
Anatomy and physiology of Eye and Optics of eye. Anatomy and physiology of Ear. Anatomy and physiology of tongue. Chemical Senses- Smell	
<b>Unit - III: Physiology of Reproduction</b>	<b>15 Hrs.</b>
Anatomy and physiology of male reproductive system. Anatomy and physiology of female Reproductive system. Maturation, capacitation of germ cells and fertilization. Embryonic development. Birth control measures.	
<b>Unit - IV: Resent trends' in Reproductive biology</b>	<b>15 Hrs.</b>
Prenatal diagnostic tests IVF and Embryo Transfer Stem cells and Tissue culture. Modern techniques in developmental biology.	

**Suggested Reading Material:**

1. Human Physiology – by A.C. Guyton. Saunders Company London, Toronto.
2. Shepherd G.M. Neuro Biology, New York Oxford University Press 1987.
3. Hurst J.W et al (eds) The Heart 7th ed. New York McGraw- Hill Book Co. 1990.
4. Hand Book of Physiology Vols. Circulation. Renkin, E.M. & Micbel, C.C. (eds) Americal Physiological Society, 1984.
5. Gayton A.C. et al. Circulation Overall regulation Annu Re. Physiol. 34: 13 1972.
6. Guyton A.C. 1980 Arterial pressure & Hypertension Philadelphia, W.B. Saunders Co- Cartiar output & its regulation 1973.
7. Kaplan N.M. et al 1989- The Kidney in Hypertension (Perspectives in hypertension vol.2) New York. Raven Press.
8. Guyton A.C. et al 1975 Dynamics & Control of the Body flerids Philadelphia, W.B. Saunders, Co., 1975.
9. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B. SaundersCo., 1986.
10. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University Press.
11. Johnson L.R. et al Physiology of the gastrointestind tract 1987 New York Raven press.
12. Thampson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book co., 1987.

13. Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
14. Guthrie H.A. 1988. Introductory Nutrition 7th ed. St.Louis C.V. Mosby Co.,
15. Felig P et al (eds) 1987. Endocrinology & Metabolism New York MacGraw- Hill Book

**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Entomology**  
**Elective paper GE-MZT23-103 Basic Entomology**  
**4 credits**

**Unit - I: INTRODUCTION TO INSECTS AND BODY PLAN (15 Hrs.)**

**1. INSECTS**

Origin and evolution of insects.

Distribution and Diversity of Insects.

Dominance of insects.

**2. BODY SEGMENTATION**

Tagmosis

Modification

**3. HEAD**

Types and segmentation

Cranium

Tentorium

Cephalic appendages

**4. CERVIX**

**Unit - II: INSECT BODY PLAN (15 Hrs.)**

**1. THORAX**

Skeleton

Segmental regions – Tergum, Sternum and Pleuron

Thoracic appendages- Legs and Wings

**2. ABDOMEN**

Typical Abdomen

Skeleton

Abdominal appendages- Pregenital, Genital and post-genital.

**Unit – III: SYSTEMATICS (15 Hrs.)**

**1. INSECT CLASSIFICATION**

Historical background

Types of Classification

Components of classification

Type specimen

**2. APTERYGOTE ORDERS**

Entognathus: Collembola

Ectognathus: Thysanura

**3. PTERYGOTE ORDERS**

Odonata, Embidina, Phasmida, Orthoptera , Isoptera, Blattaria, Anopleura.

**Unit – IV: SYSTEMATICS (15 Hrs.)**

**1. PTERYGOTE ORDERS**

Hemiptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera.

While describing Insect orders, details of the Habitat, External Morphology, Internal anatomy and Classification upto families with examples are expected.

**Suggested Reading Material:**

1. Ambrose, D.P., 2015. The Insects. Structure, Function and Biodiversity. Kalyani publishers, New Delhi. 626pp.
2. Chapman, R. F. (1998). The Insect structure and function, 4<sup>th</sup> Ed. Cambridge University Press, UK. PP 747.
3. Gillot, C. (1980). Entomology, 3<sup>rd</sup> Ed. Plenum Press, New York ,pp 730 .
4. Gullan, P. G. and Cranston, P. S., 2010. The insects. An outline of Entomology. Wiley Blackwell. pp. 565.
5. Mani, M. S. (1968). General Entomology. Oxford & IBH Publishing Co., pp 597.
6. Snodgrass, R. E. (1935). Principles of Insect Morphology, Tata Mc Graw -Hill, New York. pp 667.
7. Tembhare, D. B (2013). Modern Entomology. Himalaya Publishing House, India. pp 502.
8. Wigglesworth, V.B., 1939. The Principles of Insect Physiology. Sixth ed. Methuen and Co. Ltd., London. pp 741.

**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Elective Paper GE-MZT23-103**  
**Fisheries Resources: Inland and Marine Fisheries**  
**4 credits**

**Unit - I:** (15 Hrs.)

**A. Marine Capture Fisheries:**

Coastal fisheries: Sardine, Mackerel and Bombay duck; Off-shore fishery: Sole, Tuna, and Pomphret; Crustacean fishery and Molluscan fishery

**B. Marine Fisheries:**

Stratification of Marine habitat, and Groups of Marine Fishes

**Unit - II:** (15 Hrs.)

**A. Freshwater Fisheries of India:**

Riverine fisheries, Reservoir fisheries, and Sewage fed fisheries

**B. Carp Seed Resources of India:**

Pre-monsoon survey and selection of sites for spawn collection, Techniques of spawn collection, Spawn collection by nets, Identification, Segregation and transport, Present status of carp seed production in India.

**Unit - III:** (15 Hrs.)

**A. Management of Inland Fishery Resources:**

Fishery management in rivers and reservoirs; Reproduction, Competition, and Predation in fishes, Techniques in fishery management, Fertilization of water bodies.

**B. Management of Marine Fishery Resources:**

Biological basis of marine fishery management, Objectives of management: Biological and Non-biological, Concept of maximum sustainable yield, Fishery regulation and control of catch composition, Allocation of shares and limited entry, International fishery management i) Law of the sea, ii) Planning of future exploitation, iii) Fishery regulatory bodies; iv) Monitoring control and surveillance.

**Unit - IV:** (15 Hrs.)

**Economics of Fisheries and Extension Programme:**

Marketing and economics of fish farming, Co-operative fisheries societies, Role of government agencies in extension programme, Fisheries education, Training and extension, Problems of fisheries.

**Suggested reading material:**

1. Management of Marine Fisheries: J.A. Gullad.
2. Fishery Science: W.C. Royce.
3. Ecology, Utilization and Management of marine fisheries; G.A. Rounsefell.
4. Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.
5. Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.
6. Fish farming hand book: E.E. Brown and J.B. Gratzek.
7. Fresh water biology: K.F. Lagler.

8. Fish and Fisheries of India: V.G. Jhingran.
9. Advances in aquaculture: T.V.R. pillay.
10. Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.
11. Fishery management: S.C. Agarwal.
12. Applied fishery science (Vol. I & II): S.M. Shafi.



**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**Sericulture**  
**Elective Paper GE-MZT23-103**  
**General Sericulture and Mulberry cultivation**  
**4 credits**

**Unit-I: History and scope of Sericulture. (15 Hrs.)**

General account of global production of mulberry and non-mulberry silk,  
Silk route, Geographical distribution of mulberry and non-mulberry sericulture,  
Scope of sericulture in India

**Unit-II: Soil science and requirements for mulberry (15 Hrs.)**

Classification of different types of soil, Physical and chemical properties of soils,  
Soil testing and Management, Selection and preparation of land for mulberry cultivation  
Agro climatic zones and agro-climatic conditions for mulberry cultivation, Site suitability for  
mulberry garden establishment

**Unit-III: Mulberry cultivation practices and management (15 Hrs.)**

Characteristic features of popular mulberry varieties of tropical and temperate regions

**Propagation of Mulberry-** Scope and significance of sexual and asexual propagation,  
Methods of mulberry propagation

**Mulberry crop production-** Planning for establishment of mulberry garden  
Concept and establishment of mulberry garden for chawki & late age worms,

**Water management-** Concept of irrigation, Methods of irrigation,  
Frequency of irrigation and importance

Entrepreneurship in mulberry sapling production, Kisan nursery

**Unit-IV: Management of Mulberry Pests and Diseases (15 Hrs.)**

**Pests:** Lepidopteran pests, Coleopteran pests, Orthopteran pests, Dipterans pests,  
Hemipteran pests (Sap feeders), white fly. **Diseases:** Fungal diseases - Root rots, Powdery  
mildew disease. Leaf spot, Leaf rust etc. Bacterial diseases - Leaf blight diseases, Root knot  
diseases, Viral diseases - Mulberry leaf mosaic disease, Nematode diseases

**Suggested Reading Material:**

1. Anonymous (1972): FAO Manuals on Sericulture Vol. I – IV
2. Hanumappa (1978): Sericulture for Rural Development, Himalaya Publications, Delhi.
3. Gubrajani, M.L. (1986): Silk Dyeing, printing and finishing, IIT, New Delhi.
4. Ferguson, A. (1980): Biochemical Systematics and Evolution: Blackie Publications: Glasgo, London.
5. Yokoyama, T. (1959): Silkworm Genetics illustrated: Japan Society for Promotion of Science, Tokyo.
6. King, L.A. and Posse R.D. (1990): Baccuiovirus Expression System? Chapman and

- Hall, London.
7. Byung, Jo. (1987): Silk Textile Engineering, Moon, Halk Publication Scol. Korea.
  8. Rayner Hollin (1903): Silk Throwing and Waste Silk Spinning Scott. Greenwood and Sons, London.
  9. Koshy, T.D. (1990): Exports and Development, Ashish Publications, New Delhi.
  10. Singh, B.D.: Plant breeding, Kalyani Publishers, New Delhi.
  11. Tazima, Y. (1978): The silkworm. An important laboratory tool, Hodansha Publication, Tokyo.
  12. Anonymous (1972): Hand Book of silk rearing, Agriculture techniques Manual I., Fuji Publication, Tokyo.
  13. Jolly, M.S.: Appropriate Sericultural Techniques CSR and TI Mysore.
  14. Strunnikov, V.A. (1983): Control of silkworm reproduction, Development and sex MIR publications, Moscow.
  15. Jolly, M.S. Sen S.K. and Ahsan M.M. (1974): Tassar culture, CSTRI, Ranchi.
  16. FAO, Volumes (1-4), Central Silk Board, Bangalore

**M. Sc. Zoology**  
**M. Sc. I, Semester I**  
**RM-MZT23-104 Research Methodology**  
**4 credits**

**Unit I: Bioinstrumentation** **(15 Hrs.)**

1. **Centrifugation techniques.** Basic principles of sedimentation and centrifuges and their uses, differential centrifugation, density gradient centrifugation.
2. **Chromatographic techniques** – Chromatography theory & practices, molecular sieve chromatography, affinity chromatography, ion exchange chromatography, HPLC, GLC, and Thin Layer Chromatography.
3. **Electrophoretic techniques** – General principles, support media, electrophoresis of proteins and nucleic acids, Isoelectric focusing.
4. **Spectroscopic techniques:** UV and Visible light Spectroscopy, Spectrofluorimetry.
5. **Microscopic techniques:** Light microscope, phase contrast microscope, fluorescence microscope, Electron Microscope (SEM & TEM).
6. **Immunological techniques-** Immunoprecipitation, Labelling antibodies, immunoblotting, immunoassays, immunohisto/cytochemistry.

**Unit II: Biostatistics in Research** **(15 Hrs.)**

1. **Processing of data:** Classification and tabulation.
2. **Data Analysis:** Descriptive- Measurement of Central Tendencies, Measures of Variations, Correlation, Regression, multiple discriminant analysis (MDA), Analysis of Variance (ANOVA), Analysis of Co-Variance (ANCOVA), Multivariate analysis of variance (MANOVA), Multidimensional scaling.
3. **Inferential-** Hypothesis testing, T- tests, Chi-square test, post-hoc tests. Concept of probability.
4. **Introduction to computer programs used for biostatistics:** MS-Excel, SPSS, STATISTICA, PAST, r- statistics, PRIMER etc.

**Unit III: Scientific research, its Communication** **(15 hrs.)**

1. **Concept of Scientific Research:** Nature and types of research; research methods, experimental design, research process (formulation of the problem, literature survey, Developing working problem, designing methodology of data collection, Analysis of Data and its presentation); Concept of good research.
2. **Literature Survey and Problem Definition:** Need for Reviewing Literature, what to review and for what purpose, Literature Search Procedure, Sources of Literature, Planning of Review work, Note Taking, Libraries and Documentation and management of bibliography with softwares (e.g. EndNote, Mendeley etc.).
3. **Planning of Research:** Selection of a Problem for Research, Formulation of the Selected Problems, Hypothesis formation, Measurements, Research Design/Plan.
4. **Research communication:** Writing review articles, Research papers, Research projects, and Reports.

**Unit IV: Ethics in Zoological Research** **(15 hrs.)**

1. Originality, Integrity, Intellectual Property Rights, Patents, and Plagiarism in research.

2. **Ethical issues and bio-safety regulation:** DBT Guidelines for Bio-safety, Institutional Bio-safety committee and its functioning.
3. **Ethics in use of Experimental animals:** Institutional Animal Ethics Committee, Institutional ethical committee, CPCSEA guidelines for animal experimentation, ICMR guidelines for experiments involving humans.
4. **Biodiversity laws:** Guidelines and regulations of Bioresources utilization for commercial and research purposes. The Biological Diversity Act, Wildlife (Protection) Act, and Forest (Conservation) Conservation Act.

**References Books:**

1. Kothari. C. R. 2004. Research Methodology: Methods and Techniques, New Age International (P) Limited, Publishers, New Delhi – 110002.
2. Jennifer Peat. 2002. Scientific Writing Easy when you know how. BMJ Books.
3. Brendan Hennessy. 2006. Writing Feature Articles, Fourth edition, Focal Elsevier.
4. Margaret Cargill and Patrick O'Connor. 2009. Writing Scientific Research Articles: Strategy and Steps. Willey-Blackwell, A John Wiley & Sons, Ltd., UK. Practical Biochemistry By Wilson and Walker
5. Cell: A molecular approach By Cooper
6. Molecular Biology of the Cell by Lodish *et al.*
7. Fundamentals of Statistics- Gupta S. C.
8. Basic Biostatistics and its applications- Datta A. K
9. Biostatistics and Biometry- Parihar and Parihar.
10. An Introduction to statistical Methods- C. B. Gupta.
11. Introduction to Biostatistics by Larry Winner, Department of Statistics, University of Florida.
12. Camp, W.H. (1951): Biosystematics Britania 7: 113 – 127.
13. Huxley, J.S. (ed.) The New Systematics Oxford Univ. Press London 538 pp.
14. Jeffrey, C. (1977): Biological nomenclature Indian Ed. Oxford and IBH Pub. Co. New Delhi 72 pp.
15. Mayr, E. (1969): Principles of systematic in Zoology Mc. Graw Hill N.Y. 428 pp.
16. Mayr, E. and E.G. Linsley and R.L. Usinger (1953): Methods and Principles of systematic Zoology, Mc Graw Hill N.Y. 328 pp.

**Practical I MJ-MZP23-105**  
**Based on MJ-MZT23-101 & MJ-MZT23-102**  
**4 credits**

1. Demonstration of extracellular material
  - a. Collagen
  - b. Elastin
2. Demonstration of Glycosaminoglycans in the extracellular material using
  - a. AB-1
  - b. AB-2.5
  - c. PAS
  - d. AF +AB 2.5 (Sialic Acid)
  - e.  $MgCl_2$  influence on alcinopilia.
3. Demonstration of Nucleus by
  - i) Basic Dyes: TB, HE, Methylene blue.
  - ii) Feulgen reaction Effect of temperature
4. Lysosome demonstration (Acid phosphatase and any other method)
5. Golgi bodies demonstration (Cajal Method)
6. Demonstration of mitochondria
7. Effect of tonicity of solutions on plasma membrane –
  - a) Isotonic, Hypotonic, Hypertonic
  - b) Fragility test of RBC & Osmotic Resistance.
8. Study of generalized insect. Identification economic importance of following insect pests (6-8 pests from each category)
9. Pests of stored gains.
10. Household pests.
11. Pests of medical importance.
12. Pests of veterinary importance.
13. Forest pests.
14. Types of silk moths.
15. Rearing appliances of mulberry silk worm and demonstration.
16. Study of forensic insects
17. Study of nutritional insects.
18. Life cycle and types of honey bees.
19. Lac insect economic importance.
20. Field visit for demonstration of pest damage.
21. Field visit for collection of insects.
22. Any other practical set by concern teacher.

## **Practical II MJ-MZP23-106**

Based on GE-MZT23-103 (As per elective chosen by a student)

**2 credits**

### **Cell Biology**

1. Isolation of DNA
2. Isolation of RNA
3. Estimation of DNA
4. Estimation RNA
5. Separation of DNA by Agarose gel electrophoresis
6. Separation of RNA by Agarose gel electrophoresis.
7. Spectrophotometric analysis of nucleotides.
8. Spectrophotometric analysis of amino acids.
9. Isolation of Histones
10. Estimation of Histones.
11. Demonstration of Histones.
12. Estimation of phosphate from isolated nucleic acids.
13. Separation of proteins by SDS-PAGE
14. Western blotting
15. Northern blotting
16. Southern blotting.
17. Isolation of plasmids.
18. Any other practical set by concerned teacher.

### **Animal Physiology**

1. Study of histology and histochemistry of reproductive organs.
2. Vaginal smear technique.
3. Study of Uterine muscles.
4. Study of sperm count.
5. Capacitation and motility of sperm.
6. Study of placental type.
7. Contraceptive devices.
8. Gonadectomy in white rat
9. Estimation of lactate content of rat blood.
10. Estimation of calcium content of rat blood.
11. Any other practical set by concerned teacher.

### **Entomology**

1. Collection and preservation of insects.
2. Study of mouth parts in insects.
3. Study of antennae in insects.
4. Mounting of tentorium.
5. Study of types of wings in insects.
6. Study of types of legs in insects.
7. Study of abdominal appendages in Cockroach and Grasshopper.
8. Study of locally available insect orders with examples.
9. Any other practical set by concerned teacher.

### **Aquaculture and Fisheries**

1. Identification of important food fishes, prawns and molluscs upto the species level (Freshwater and Marine)
2. Estimation of the rate of oxygen consumption in fish
3. Fecundity assessment in fish
4. Slides of different types of scale
5. Demonstration of induced breeding technique by ovaprim / ovatide.
6. Estimation of DO, CO<sub>2</sub>, Alkalinity, Inorganic nitrate and Phosphate from water sample
7. Qualitative analysis of digestive enzymes
8. Any other practical set by concerned teacher.

### **Sericulture**

1. Demonstration of mulberry cultivation.
2. Preparation of mulberry saplings
3. Demonstration of pruning and application of chemical fertilizers
4. Preparation of herbarium of mulberry and non-mulberry host plants.
5. Study of anatomy of leaf, stem and petiole
6. Collection and preservation of mulberry pests
7. Study root and foliar diseases of mulberry
8. Any other practical set by the concerned teacher.

**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**MJ-MZT23-201: Physiological chemistry**  
**4 credits**

**Unit I: Chemical foundations of Biology** (15 Hrs.)

Structure of atom,  
Types of bonds, Van der Waal's electrostatic forces of attraction, hydrophobic interactions.  
Chemical structure and properties of water, pH, pKa, buffers,  
Thermodynamics in biological system: Enthalpy, Entropy and Gibb's free energy.

**Unit II: Carbohydrate metabolism** (15 Hrs.)

Structure, classification and functions of carbohydrates,  
Glycolysis, regulation and energetics,  
TCA cycle, regulation and energetics,  
Electron transfer system structure and mechanism of action, oxidative phosphorylation and ATP generation,  
Glycogenesis, glycogenolysis and gluconeogenesis  
Pentose phosphate pathway and its significance

**Unit III: Amino acids, Proteins and nucleic acids** (15 Hrs.)

Amino acids: Classification of amino acids, biosynthesis and Oxidation of amino acids.  
Proteins: Protein structure and functions: Primary, secondary, tertiary and quaternary structure  
Nucleic acids: Structure of nucleotides. Structure of DNA and RNA, De novo and salvage pathway of synthesis of nucleotides

**Unit IV: Lipid metabolism** (15 Hrs.)

Lipids- structure, classification and functions, Steroidal hormones: structure and functions.  
Catabolism of fatty acid – Beta oxidation, Carnitine shuttle, Significance of beta oxidation.  
Bioenergetics of Beta oxidation  
Biosynthesis of saturated and unsaturated fatty acids.  
Biosynthesis of triglycerides,  
Biosynthesis of membrane phospholipids.  
Biosynthesis of cholesterol  
Biosynthesis of prostaglandins and leukotriene Lipoprotein metabolism

**Reference Books**

1. Lehninger-Principles of Biochemistry: Nelson and Cox
2. Biochemistry:, Tymoczko, Berg, Stryer
3. Review of physiological chemistry: H. Harper



**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**MJ-MZT23-202: Anatomy and Physiology**  
**4 credits**

**Unit I: Physiology of Digestive System: (15 Hrs.)**

- 1.1 Anatomy and physiology of gastrointestinal tract, Salivary gland, Pancreas and Liver.  
Digestion and absorption in gastrointestinal tract  
Balanced diet, obesity and starvation.  
Vitamins and their role in nutrition.

**Unit II: Physiology of Respiration: (15 Hrs.)**

- Anatomy and physiology, respiratory tract and pulmonary ventilation.  
Pulmonary air volumes and capacities.  
Exchange of Oxygen and carbon dioxide.  
Control of respiration.

**Unit III: Physiology of Circulation: (15 Hrs.)**

- Blood, Composition of blood, blood coagulation.  
Blood groups and blood transfusion.  
Anatomy and physiology Heart and blood vessels, Heart blood supply.  
Conduction system and pace maker.  
Electrocardiogram, Cardiac Cycle and heart sound.

**Unit IV: Physiology of Excretion and Endocrine System: (15 Hrs.)**

- Anatomy and physiology of the kidneys, nephron and mechanism of urine formation.  
Urinary bladder, process of micturation, Hemodialysis and Artificial kidney.  
Anatomy and physiology of Pituitary gland and Adrenal gland.  
Anatomy and physiology of Thyroid and Parathyroid gland.

**Reference:**

1. Human Physiology – by A.C. Guyton. Saunders Company London, Toronto.
2. Shepherd G.M. Neuro Biology, New York Oxford University Press 1987.
3. Hurst J.W et al (eds) The Heart 7th ed. New York McGraw- Hill Book Co. 1990.
4. Hand Book of Physiology Vols. Circulation. Renkin, E.M. & Michel, C.C. (eds) American Physiological Society, 1984.
5. Guyton A.C. et al. Circulation Overall regulation Annu Re. Physiol. 34: 13 1972.
6. Guyton A.C. 1980 Arterial pressure & Hypertension Philadelphia, W.B. Saunders Co- Cardiac output & its regulation 1973.
7. Kaplan N.M. et al 1989- The Kidney in Hypertension (Perspectives in hypertension vol.2) New York. Raven Press.
8. Guyton A.C. et al 1975 Dynamics & Control of the Body fluids Philadelphia, W.B. Saunders, Co., 1975.
9. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B. Saunders Co., 1986.
10. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University press.
11. Johnson L.R. et al Physiology of the gastrointestinal tract 1987 New York Raven press.
12. Thompson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book co., 1987.

13. Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
14. Guthrie H.A. 1988. Introductory Nutrition 7th ed. St.Louis C.V. Mosby Co.,
15. Felig P et al (eds) 1987. Endocrinology & Metabolism New York MacGraw- Hill Book Co.,
16. DeGroot L.J. et al 1989. Endocrinology 2nd ed. Philadelphia, W.B. Saunders Co. 1989.
17. Kannan, C.R. 1988. The adrenal gland New York Plenum Pub. Corp.

**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**Cell Biology**  
**Elective Paper GE-MZT23- 203 Developmental Biology**  
**4 credits**

**Unit – I:** (15 Hrs.)

**An introduction to developmental biology:**

Introduction, features of animal development, eukaryotic heritage, development among the unicellular eukaryotes, control of developmental morphogenesis and differentiation, origin of sexual reproduction, colonial eukaryotes, the evolution of differentiation, developmental pattern among metazoans

**Unit - II: Gametogenesis, fertilization and early embryonic development** (15 Hrs.)

Production of gametes,  
Cell surface molecules in sperm-egg recognition in animals,  
Process of fertilization, cleavage,  
Blastulation in sea urchin, Amphioxus, Zebra fish, frog, chick and mammal.  
Implantation in mammals

**Unit – III: Gastrulation and Neurulation** (15 Hrs.)

- a. Gastrulation and formation of germ layers in sea urchin, frog, birds, reptiles and mammals,;
- B.Molecular mechanism of left –right axis formation- in amphibian ,mammal and reptile
- c. Neurulation-body segmentation, Hox gene control development

**Unit – IV: Morphogenesis and organogenesis in animals** (15 Hrs.)

- a. Cell aggregation and differentiation in *Dictyostelium*- Life cycle of dictyostelium, cell-cell signaling, cell adhesion molecules in *Dictyostelium*
- b. Axes and pattern formation in *Drosophila*-Development of fruit fly , maternal effect gene,
- c. Organogenesis – vulva formation in *Caenorhabditis elegans*-cell-cell interactions and chance in the determination of cell types
- d. Eye lens induction- Cascades of induction –reciprocal and sequential inductive events

**References**

1. Developmental Biology By Gilbert
2. Molecular cell biology by Lodish, Berk, Matsudaira, Kaiser, Krieger (2004) published by W. H. Freeman & company, New York.
3. The Cell by Bruce Alberts, published by Garland publishing Inc. New York & London
4. Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.
5. Cell & Molecular Biology by E.D.P. De Robertis

**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**Animal Physiology**  
**Elective Paper GE-MZT23-203 Applied Physiology**  
**4 credits**

**Unit - I: Environmental Physiology** **15 Hrs.**

- 1.1. Physiology of high altitude.
  - Space Physiology and Weightlessness.
  - Physiology of deep sea diving.
  - SCUBA and its bio-applications.

**Unit - II: Exercise Physiology** **15 Hrs.**

- Fundamental of physical and mental exercise.
- Energy for exercise - Aerobics and Anaerobics.
- Exercise physiology- Muscles in exercise, Respiratory exercise, Cardiovascular system exercise, Nervous system exercise and thermodynamics of exercise
  - Hormonal changes and exercise.
  - Exercise, meditation and mental health.

**Unit - III: Ergonomics of Bio-equipment'** **15 Hrs.**

- 3.1 Laboratory equipment's- Ergonomics and its applications.
- 3.2 Ergonomic working and applications of Spigmomanometer, ECG and TMT.
  - Ergonomic working and applications of Spirometer and Grip ergometer.
  - Ergonomic working and applications of Ultrasound and C. T. Scan.
  - Ergonomic working and applications of Endoscopy and tissue biopsy.
  - Ergonomic working and applications of MRI and EEG.

**Unit – IV: Ergonomics and Occupational Physiology** **15 Hrs.**

- 4.1. Man- machine and working environment.
  - Occupational hazards or diseases and its management
  - Muscular atrophy and dystrophy.
  - Biological and mental stresses
  - Problems of Child labour.

**Suggested Reading Material:**

1. Human Physiology – by A.C. Guyton. Saunders Company London, Toronto.
2. Shepherd G.M. Neuro Biology, New York Oxford University Press 1987.
3. Hurst J.W et al (eds) The Heart 7th ed. New York McGraw- Hill Book Co. 1990.
4. Hand Book of Physiology Vols. Circulation. Renkin, E.M. & Micbel, C.C. (eds) Americal Physiological Society, 1984.
5. Gayton A.C. et al. Circulation Overall regulation Annu Re. Physiol. 34: 13 1972.
6. Guyton A.C. 1980 Arterial pressure & Hypertension Philadelphia, W.B. Saunders Co- Cartiar output & its regulation 1973.
7. Kaplan N.M. et al 1989- The Kidney in Hypertension (Perspectives in hypertension vol.2) New York. Raven Press.
8. Guyton A.C. et al 1975 Dynamics & Control of the Body flerids Philadelphia, W.B. Saunders, Co., 1975.
9. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B. Saunders Co., 1986.
10. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University Press.

11. Johnson L.R. et al Physiology of the gastrointestind tract 1987 New York Raven press.
12. Thampson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book co., 1987.
13. Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
14. Guthrie H.A. 1988. Introductory Hutrition 7th ed. St.Lonis C.V. Mosby Co.,
15. Felig P et al (eds) 1987. Endocrinology & Metabolism New Your MacGraw- Hill Book Co.,
16. DeGroot L.J. et al 1989. Endocrinology 2nd ed. Philadelphia, W.B. saunders Co. 1989.
17. Kannan, C.R. 1988. The adrenal gland New York Plenum Pub. Corp.

**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**Entomology**  
**Elective Paper GE-MZT23-203 Agricultural Entomology**  
**4 credits**

**Unit –I: (15 Hrs.)**

1. Definition of Pest, General characters, Habitats, Damage, Economic Threshold Level, Economic Injury Level, Causes for insect assuming pest status, Types of damage to plant by insects and their estimation.

Identification, characteristics, biology, damage and Management of important agricultural pests.

**2. Pests of Cereals:**

Paddy and Jowar stem borers, midge fly, aphid, Grasshopper, Paddy Leaf hoppers, armyworm, cutworm, and blister beetle.

**3. Pests of pulses:**

Gram pod borer, Cutworms, Turplume moth, Turpod Bug, Turpod fly, Lentilpod borer, and Beanfly.

**Unit –II: (15 Hrs.)**

**4. Pests of fruits and fruit trees (Temperate):**

Sanjose scale, apple wooly aphid, white fly, cherry stem borer, codling moth, apple stem borer, peach fruit fly and Almond weevil.

**5. Pests of fruits and fruit trees:**

Citrus caterpillar, citrus psylla, citrus white fly, citrus fruit moth, Mango stem borer, Mango jassid, Mango mealy bug, Mango stone weevil, Mango fruitfly, Grapevine mealy bug, grapevine thrips, Pomegranate (anar) butterfly, Banana weevil, papaya AK grasshopper

**Unit –III: (15 Hrs.)**

**6. Pests of sugar cane:**

Sugarcane woolly aphids, White grubs, borers, Pyrilla, Whitefly, Mealybug, Termites.

**7. Pests of fiber crops:**

Cotton pink boll worm, Spotted boll worms, American boll worm, Red cotton bug, Dusky cotton bug, cotton aphid, cotton leafroller, Bihar hairy caterpillar on jute and sun hemp capsid.

**8. Pests of Oilseed Crops:**

Mustard aphid, Mustard Sawfly, groundnut aphid, groundnut stemborer, cutworm, Bihar hairy caterpillar white grub, castor semilooper, castor capsule borer, Til hawkmoth, linseed gall midge, Sunflower head borer, safflower aphid.

**Unit –IV: (15 Hrs.)**

**9. Pests of vegetable crops:**

Cabbage caterpillar, Diamond back moth, potato tuber moth, Onion thrips, Brinjal fruit & stem borer, Jassid, mealy bug, whitefly, Red pumpkin beetle and Hadda beetle.

**10. Pests of plantation crops:**

Coffee stem borer, coffee shoothole borer, Tea mosquito bug, coconut weevil, and

and Rhinoceros beetle

### **11. Pests of Spices and Narcotic:**

Chilli thrips, castor capsule borer, white grub, Bihar hairy caterpillar, Tobacco caterpillar, Tobacco aphid and Hesperid caterpillar.

#### **Suggested Reading Material:**

1. Agricultural pest of India and South East Asia, By A.S. Atwal, Kalayni publ. New Delhi.
2. Hand Book of Economic Entomology for South India by T.U. Ramkrishna Ayyar.
3. A textbook of Agricultural Entomology. ICAR New Delhi by Druthi S.H.
4. A text book of Applied Entomology, By K.P. Shrivastava Kalyani Publ. New Delhi.
5. Agrochemicals and pest management, DPH New Delhi by T.V. Sathe.
6. Modern Entomology by Tembhare

**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**Aquaculture and Fisheries**  
**Elective Paper GE-MZT23-203 Fish Pathology and Reproductive Endocrinology**  
**4 credits**

**Unit - I: Fish Pathology and Cure** (15 Hrs.)

Signs of sickness in fishes, defensive devices in fishes against diseases, diseases of fishes, intrinsic causes of diseases, diseases caused by pathogens and parasites; their symptoms and treatments

**Unit - II:** (15 Hrs.)

**A. Larvivorous Fish in Relation to Pulic Health:**

Essential characters of Larvicidal Fish, Larvicidal fishes in India, Classification of Fishes based on Mosquitocidal activity

**B. Aquatic Pollution:**

Introduction, water pollution: causes and types, Major sources of aquatic pollution and their effects on fish and fisheries

**Unit - III:** (15 Hrs.)

**Fish Health in Relation to Environment:**

Abiotic factors influencing disease outbreak in fish, Effect of industrial waste on diseases and pathogens; Effect of agriculture waste on diseases and pathogens, Effect of pesticides substances on fish in relation to water quality.

**A. Epizootic Ulcerative Syndrome (EUS):**

History and areas affected by EUS, Spread of disease and fish species affected, Present state of knowledge of EUS, Extension of range and human significance, Recommendations for treatment, Socio-economic impact of EUS.

**Unit - IV:** (15 Hrs.)

**Reproductive Endocrinology:**

Pituitary gonadotropins: role of gonadotropins in pre-spawning behaviour, role of gonadotropins in spawning behavior, Hormonal regulation in fish reproduction

**Suggested reading material:**

1. Fish physiology (Vol.I to XII): W.S. Hoar and D.J. Randall.
2. Fish endocrinology: A.J. Matty.
3. Fishery science: W.F. Royce.
4. Introduction to fishes: S.S. Khanna.
5. Pond fisheries: F.G. Martyshev.
6. Fresh water fishery biology: K.F. Lagler.
7. Coastal Ecosystem management: John Clark.
8. Applied Fishery Science Vol. I & II : S.M. Shafi.



**M. Sc. Zoology**  
**M. Sc. I, Semester II**  
**Sericulture**  
**Elective Paper GE-MZT23-203 Silkworm Biology & Rearing Technology**  
**4 credits**

**Unit - I: Silkworm Biology** (15 Hrs.)

Classification and Geographical distribution of Silkworm races  
Life cycle of mulberry silkworm  
Life cycle of non-mulberry silkworms  
Eri, Muga and Tasar

**Unit - II: Anatomy and Physiology of mulberry silkworm** (15 Hrs.)

Digestive system, Circulatory system, Excretory system,  
Nervous system, Respiratory system,  
Reproductive system and Endocrine system  
Anatomy, silk gland structure and function

**Unit - III: Rearing technology and management practices** (15 Hrs.)

Principles of silkworm rearing, Environmental conditions for silkworm rearing  
Rearing equipments, Management of rearing house and disinfection  
Types of rearing houses, Types of silkworms and methods of commercial rearing Chawki  
Rearing concept, shoot feeding and shelves rearing technology

**Unit - IV: Silkworm diseases and management** (15 Hrs.)

Protozoan diseases, Bacterial diseases, Viral diseases, Fungal diseases and their management  
practices Pests, Predators, Parasites of mulberry and non-mulberry silkworm and management

**Suggested Reading Material:**

1. Sarkar, D.C. (1988): Sericulture in India, CSB, Bangalore.
2. Annual report of Central Sericultural Research and Training Institute, Mysore.
3. Annual report of Central Sericultural Research and Training Institute, Bangalore.
4. Annual report of Central Tasar Research Institute, Ranchi.
5. Annual report of Central Muga Research Institute, Assam.
6. Statistical Biennial, CSB Publication, Bangalore.
7. Bibliography on Mulberry, CSIR and IIT, Mysore.
8. A Treatise on acid treatment of silkworm eggs, CSR and TI, Mysore.
9. Probe / Kematic soils of tropical mulberry garden and their management, CSR & TI, Mysore.
10. Tips for successful silkworm cocoon crops, CSR and TI, Mysore.
11. Tips for successful bivoltine silkworm cocoon crops, CSR and TI, Mysore.
12. M.V. Samson, Chandrashekharaiah, P. Gowde and Saheb B. (1995): Monograph on silkworm loose egg production, SSTC, CSB, Bangalore.
13. CSTRI improved multiple reeling machines, CSRTI CSB Bangalore, 1995.
14. CSTRI improved Charkha, 1995, SCTRI, CSB, Bangalore.
15. Water Management in silk reeling machine, CSTRI CSB, Bangalore, 1995.
16. FAO, Volumes (1-4), Central Silk Board, Bangalore

**Practical III MJ-MZP23-205**  
**Based on MJ-MZT23-201 and MJ-MZT23-202**  
**4 credits**

1. Estimation of glycogen.
2. Estimation of lipids & phospholipids.
3. Estimation of Vitamin C.
4. Estimation of Cholesterol.
5. To find saponification value for a given fat.
6. Preparation of phosphate buffer pH measurement.
7. To estimate free amino acids by Ninhydrin method.
8. To estimate protein content by Biuret method/ Lowry et.al./ Bradford method.
9. Estimation of glucose.
10. Estimation of casein from milk.
11. Estimation of Uric acid
12. Extraction of Starch.
13. Extraction of Glycogen.
14. Determination of Bleeding time
15. Determination of Clotting time
16. Estimation of Hemoglobin (Hb) concentration and oxygen carrying capacity
17. Enumeration of Red blood corpuscles (R.B.C)
18. Enumeration of white blood corpuscles (W.B.C)
19. Differential count of W.B.C.
20. Erythrocyte sedimentation rate (E.S.R)
21. Detections of digestive enzymes
22. Anatomy and histology of digestive and endocrine glands
23. To estimate amylase from saliva
24. To study normal constituents of urine
25. Measurement of breathing rate, heart beat and study of heart sound.
26. Any other practical set by the concerned teacher

**Practical IV MJ-MZP23-206**  
**Based on GE-MZT23-203 (As per elective chosen by a student)**  
**2 credits**

**Cell Biology**

1. Study of eye lens differentiation in chick embryo.
2. Study of nervous system development in chick embryo.
3. Study of Angiogenesis in chick embryo.
4. Study of Dorsal nerve root development in chick embryo
5. Effect of colchicine on development of dorsal nerve root in chick embryo
6. Demonstration of stem cells
7. Study of gastrulation in amphioxus and frog
8. Study of partial hepatectomy in mice.
9. Any other experiments / practical set by the Department.

**Animal Physiology**

1. Determination of PEFr.
2. Study of physical fitness by Step Test method
3. Determination of Grip strength.
4. To study effect of work load on finger muscle by Finger Ergometry.
5. Absorption spectra of blood pigments.
6. Estimation of Chloride content in rat blood.
7. Visit to the industrial area to study man- machine environment.
8. Demonstration of principal of dialysis.
9. Demonstration of IVF procedure (Lab. visit).
10. Project work/ Review articles.
11. Study of bio-equipment's and their ergonomics features
12. Any other practical set by concern teacher.

**Entomology**

1. Pests of cereals.
2. Pests of pulses.
3. Pests of fiber crops.
4. Pests of fruit and fruit trees.
5. Pests of Oil seed crops.
6. Pests of Vegetable crops.
7. Other agricultural important insect pests
8. Field visit to study nature pest damage.
9. Any practical set by the concerned teacher

**Aquaculture and Fisheries**

1. Identification of diseased fish – Bacterial, fungal and viral infections (Slides)
2. Blood glucose estimation in fish
3. Sexual dimorphism and secondary sexual characters in fishes
4. Short term bioassay of LC50 determination (Demonstration)
5. Field trips and study tours to fish farms, fisheries institute, or national laboratory etc..
6. Any practical set by the concerned teacher / Department.

### **Sericulture**

1. Morphology of egg, larva, pupa and adult of mulberry and non-mulberry silkworms
2. Dissection of Digestive system of silkworm
3. Dissection of Nervous system of silkworm
4. Dissection of Circulatory system of silkworm
5. Dissection of male reproductive system of silkworm
6. Dissection of female reproductive system of silkworm
7. Mounting of silk gland
8. Rearing of silkworm to study its life cycle.

**Pattern of Theory paper**

**There will be five descriptive questions, each carrying 16 marks.**

Que. 1 Descriptive Question from Unit I OR Descriptive Question from Unit I	16
Que. 2 Descriptive Question from Unit II OR Descriptive Question from Unit II	16
Que. 3 Descriptive Question from Unit III OR Descriptive Question from Unit III	16
Que. 4 Descriptive Question from Unit IV OR Descriptive Question from Unit IV	16
Que. 5 Write notes on (Any two) a. From Unit I b. From Unit II c. From Unit III d. From Unit IV	16

**Pattern of Practical's**

<b>Practical I MJ-MZP23-105</b>	<b>100 marks</b>
(Based on MJ-MZT23-101 and MJ-MZT23-102)	
Que. 1 Experiment/Experiments Based on <b>MJ-MZT23-101</b>	20
Que. 2 Experiment/Experiments Based on <b>MJ-MZT23-101</b>	20
Que. 3 Experiment/Experiments Based on <b>MJ-MZT23-102</b>	20
Que. 4 Experiment/Experiments Based on <b>MJ-MZT23-102</b>	20
Que. 5 Viva voce	10
Que. 6 Journal	10

For passing in **MJ-MZP23-105**, student must score minimum 40 marks out of 100 in practical examination

<b>Practical II MJ-MZP23-106</b>	<b>50 marks</b>
(Based on GE-MZT23-103)	
Que. 1 Experiment/Experiments Based on E101	20
Que. 2 Experiment/Experiments Based on E101	20
Que. 5 <i>Viva voce</i>	05
Que. 6 Journal	05

For passing in **MJ-MZP23-106**, student must score minimum 20 marks out of 50 in practical examination

<b>Practical III MJ-MZP23-205</b>	<b>100 marks</b>
(Based on MJ-MZT23-201 and MJ-MZT23-202)	
Que. 1 Experiment/Experiments Based on <b>MJ-MZT23-201</b>	20
Que. 2 Experiment/Experiments Based on <b>MJ-MZT23-201</b>	20
Que. 3 Experiment/Experiments Based on <b>MJ-MZT23-202</b>	20
Que. 4 Experiment/Experiments Based on <b>MJ-MZT23-202</b>	20
Que. 5 <i>Viva voce</i>	10
Que. 6 Journal	10

For passing in **MJ-MZP23-205**, student must score minimum 40 marks out of 100 in practical examination

<b>Practical MJ-MZP23-206 Based on GE-MZT23-203</b>	<b>50 marks</b>
Que. 1 Experiment/Experiments Based on <b>GE-MZT23-203</b>	20
Que. 2 Experiment/Experiments Based on <b>GE-MZT23-203</b>	20
Que. 5 <i>Viva voce</i>	05
Que. 6 Journal	05

For passing in **MJ-MZP23-206**, student must score minimum 20 marks out of 50 in practical examination.