

**Rayat Shikshan Sanstha's
YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA
(Lead College Karmveer Bhaurao Patil University, Satara)**

Reaccredited by NAAC with 'A+' Grade

Syllabus For

Master of Science

Part - I

Zoology

Semester I and II

**Syllabus to be implemented from Academic Year 2023-24
(As per NEP-2020 Guideline)**

A. RULES AND REGULATIONS:

- 1.** Any person who has taken the degree of B. Sc. of this Institute or the degree of any other statutory University and has kept four terms in the Institute as post-graduate student be admitted to the examination for the degree of Master of Science (M. Sc.) in Zoology
- 2.** A student shall be held eligible for admission to the M. Sc. Zoology course provided she/he has passed the B. Sc. examination with Zoology as a principal subject or with a subsidiary/interdisciplinary/applied/allied subjects and has passed the entrance examination conducted by the Institute.
- 3.** The students with B. Sc. from other universities shall be eligible if they qualify through the entrance examination.
- 4.** While preparing the merit list for M. Sc. admission, the performance at the entrance examination should be considered.
- 5.** The examination shall be split up into four semesters.
- 6.** The commencement and conclusion of each semester shall be notified by the Institute from time to time.
- 7.** A student who has passed in semester examination shall not be allowed to take the examination in the same semester again.
- 8.** Each theory Course in each semester as well as each practical course shall be treated as separate head of passing.
- 9.** The result shall be declared at the end of each semester examination as per Institute rules.

B. Syllabus for Master of Science (M. Sc.)

1. TITLE: Zoology

2. YEAR OF IMPLEMENTATION: 2023-24 onwards

3. PREAMBLE:

M. Sc. Zoology course under autonomy has been prepared keeping in view the unique requirements of M. Sc. Zoology students. The prominence of the contents is to provide students the latest information along with due weightage to the concepts of traditional zoology so that they are able to understand and appreciate the current interdisciplinary approaches in the study of animal sciences and its role in societal and environmental development. The course content also advanced practical exercises so the students gets a hands on experience of the newest techniques that are currently in use. Project curriculum covering over the two years of the course which is designed in a way that, to give the students first hand research experience as it consists of writing of synopsis, literature review along with actual laboratory work and handling laboratory instruments. The course will also encourage students to hunt higher studies and research in life sciences, for becoming an entrepreneur and enable students to get employed in research institutes.

4. GENERAL OBJECTIVES OF THE COURSE:

- To impart the knowledge of animal science is the basic objective of the course.
- To develop scientific attitude among the students and to make the students open minded, enthusiastic, critical and curious so that they enter research field with a positive approach.
- To develop skill in practical work, experiments and handling laboratory instruments.
- To understand scientific terms, concepts, facts, phenomenon and their relationships.
- To make the students aware of natural resource, diversity, environment up to cell biology.
- To enable the students to acquire knowledge of animal cells and different molecules as well as genetics for the wellbeing of human.
- Enrichment of basic knowledge of techniques in zoology, bioinformatics and genetics.

5. DURATION: 02 year (4 semester)

6. FEE STRUCTURE:

- **Entrance Examination Fees:** as prescribed by the institute
- **Course Fee:** as prescribed by the institute

7. ELIGIBILITY FOR ADMISSION:

As per rule (2) for graduate of this institute

As per rule (3) for graduate from other universities and merit of entrance exam.

8. MEDIUM OF INSTRUCTION: English**9. STRUCTURE OF THE COURSE**

Level	Sem.	Major			RM	OJT	RP	Total
		DSC Mandatory		DSE Elective				
		T	P	T				
6	I	12 (3 Courses)	2	4 (1 course out of two)	4	---	---	22
	II	12 (3 Courses)	2	4 (1 course out of two)	---	---	4	22
6.5	III	12 (3 Courses)	2	4 (1 course out of two)	---	---	6	22
	IV	12 (3 Courses)		4 (1 course out of two)	---	4	---	22
Total		48	6	16	4	4	10	88
		70			8		10	

[M: M.Sc., Z: Zoology, T : Theory, P : Practical, OJT- on job training, RT- Research training, RM- Research methodology, DSC- Discipline Specific Core, DSE- Discipline Specific Elective, E1 – Elective 1, E2- Elective2]

M. Sc. Part I

Semester I

Nature of the Course	Course Code	Name of the Course
Theory	MZT 411	Biosystematics and Biodiversity
	MZT 412	Ecology and Environmental Pollution
	MZT 413	Cell and Molecular Biology
	MZT 414 (E 1)	Applied Entomology
	MZT 414 (E 2)	Histology and Histochemistry
	MZT 415	Research Methodology
Practical	MZP 416	Practical course I : Lab I Based on MZT 411,412,413)

Semester II

Nature of the Course	Course Code	Name of the Course
Theory	MZT 421	Physiological Chemistry
	MZT 422	Tools and Techniques in Zoology
	MZT 423	Elements of Physiology
	MZT 424 (E1)	Biology of Parasites
	MZT 424 (E2)	General Endocrinology
	MZT 425	Research Project
Practical	MZP 426	Practical course II : Lab II Based on MZT 421,422,423)

SEMESTER I

MZT 411: Biosystematics and Biodiversity

Course Objectives: Student should be able to

1. Define taxonomy, and various tasks of taxonomists.
2. Summarize the different concept of species for taxonomic identification of the species.
3. Recite the concepts of hotspot diversity and roles to conserve that diversity.
4. Justify the roles played by NGOs, and different communities in conserving the biodiversity.

Credits=4	MZT 411: Biosystematics and Biodiversity	No. of hours per unit/ credits
I	<p>1. Taxonomy Introduction to taxonomy Stages and importance of taxonomy; Problems Aim and Tasks of Taxonomy.</p> <p>2. Modern Trends in Taxonomy: Morphological approach, Immature stages and Embryological approach, Ecological, behavioral and Cytological approach.</p> <p>3. Methodologies in systematic : Molecular markers for detection/evaluation of polymorphism, RFLP, RAPD etc.</p>	15
I	<p>1. Speciation Types (sibling, sympatric, allopatric, etc) Species isolation (Reproductive, geographic, Ecological, temporal, behavioural, gametic) R& K Selection</p> <p>2. Zoological nomenclature: Origin of the code, International code of Zoological nomenclatures Rules of nomenclature. Species and their number, polytypic species, Subspecies, other intraspecific group, super species.</p>	15

I	<p>1. Biodiversity Science: Evolution of biodiversity, Factors promoting high diversity, Endemism and Hotspots, Measures of Bio-diversity, Uses and Importance of Biodiversity.</p> <p>2. Biodiversity indices (Shannon- Weiner, Simpson's)</p>	15
I	<p>1. Biodiversity Conservation: Loss and Threats of biodiversity, listing of threatened biodiversity, Role of NGOs, Colleges and Universities. IUCN Guidelines for Red List categories and criteria (version 7.0), Red List of Indian Flora and Fauna.</p>	15

Course outcomes: Student will be able to:

- 1) Define taxonomy, and various tasks of taxonomists.
- 2) Summarize the different concept of species for taxonomic identification of the species.
- 3) Recite the concepts of hotspot diversity and roles to conserve that diversity.
- 4) Justify the roles played by NGOs, and different communities in conserving the biodiversity.

References:

1. Alston, R.E. and B.L. Turner (1963): Biochemical systematics Prentices Hall Inc. Englewood Cliffs, N.J. 404 pp.
2. Avise, J.C. (1974): Systematic value of Electrophoretic data. Syst. Zool. 23 (4): 465 – 481.
3. Benazzi, M. (1973): Cytotaxonomy and evolution, General remarks vertebrate evolution. Ed. A.B. Chiarelli and Campus Academic Press, London and N.Y. pp. 1-3.
4. Blomback, B and M. Blomback (1968): Primary structure of animal proteins as a guide in taxonomic studies. In chemitaxonomy and serotaxonomy (ed.) Hawkers pp. 3 – 20.
5. Camp, W.H. (1951): Biosystematics Britania 7: 113 – 127.
6. CHamberlin, W.J. (1952): Entomological Nomenclature and Literature 3rd edition Dubuvuelowa William C. Brown Co.
7. Cole, A.J. (1969): Numerical taxonomy proceedings of the colliqui innumerical taxonomy held in the University of St. Andrews Sept. 1968. AcademicPress, N.Y 324 pp.
8. Hennig, W. (1966): Phylogenetic systematics Univ. Illinois Press III, 263 pp.
9. Heywood, V.H. (1973): Taxonomy and Ecology Systematics Association special Vol. 5 Academic Press, London, and New York 370 pp.
10. Huxley, J.S. (ed.) The New Systematics Oxford Uiv. Press London 538 pp.

MZT 412: Ecology and Environmental Pollution

Course objectives: Student should be able to:

1. Describe behavioral and physiological mechanisms by which organisms interact with other organisms and with their physical environment.
2. Explain the importance of biodiversity to ecosystems, energy flow.
3. Describe the role and sources of pollutants.
4. Criticize sources of pollution and their pollutants along with their control measures.

Credits=4	MZT 412: Ecology and Environmental Pollution	No. of hours per unit/ credits
I	<p>1. Habitat and Niche: Concept and types of habitat Ecological niche Niche width and overlap</p> <p>2. Species interaction: Types of interactions Interspecific competition Intraspecific competition</p> <p>3. Community ecology: Types and nature of communities Structure of community Community dominance Edge and ecotones.</p>	15
I	<p>1. Ecological Succession: Types of succession Process of succession Patterns of succession</p> <p>2. Environmental Impact Assessment: Definition and scope, Characteristics, objectives, components, methodology, Procedure for obtaining EIA clearance, Preparation of EIA document.</p>	15

I	<p>1. Concept, Scope and Definitions of Environmental Pollution Types of pollutants- based on physical properties, forms, Causes of environmental pollution, Pollution in relation to public health (Air, water, pesticide and radiation pollution).</p> <p>2. Air pollution: Definition, Sources, Principle air pollutants, Effects of air pollutants. Smog – Classical smog and industrial pollution, Photochemical smog and vehicular emission. 2.6 Prevention and control of air pollutants.</p> <p>3. Radioactive pollution – Types, Sources and effects of radiation.</p> <p>4. Agricultural pollution- Farm animal waste, Soil erosion plants residues, agrochemical- fertilizers and pesticides.</p>	15
I	<p>1. Water pollution- Definition, Sources of water pollution, Types of water pollutants and their effects, BOD and COD water pollution control, Sewage treatment.</p> <p>2. Environmental Legislation: Central and state boards for the prevention and control of environmental pollution, Powers and functions of pollution control boards, Penalties and procedure, Duties and responsibilities of citizens for environmental protection, Wildlife Protection Act 1972.</p>	15

Course outcomes: Student will be able to:

1. Describe behavioral and physiological mechanisms by which organisms interact with other organisms and with their physical environment.
2. Explain the importance of biodiversity to ecosystems, energy flow.
3. Recite the role and sources of pollutants.
4. Categorize sources of pollution and their pollutants along with their control measures.

References:

1. Dash and Dash Fundamentals of Ecology-
2. Basic Ecology- Odum E. P
3. Odum E.P Fundamentals of Ecology-
4. K. D.Kumar. Modern concepts of ecology-
5. H. D. Kumar. Concepts of Ecology-
6. P. D.Sharma. Ecology -
7. Laurent Hodges. (1977) Environmental pollution Half, Rinehart and Winston, New

York -

8. Pandey Kamleshwar., Shuklar J. P .and Trivedi S.P. (2005), Fundamental of Toxicology. New Central book agency PVT. LTD. Kolkata

MZT 413: Cell and Molecular Biology

Course objectives: Student should be able to:

1. Explain the models of membrane structure and diffusion of molecules passing through it.
2. Give original example of pattern of protein secretion and its intracellular transport through vesicles.
3. Demonstrate the structure and function of cell organelles.
4. Criticize importance of cell cycle, checkpoints and signal transduction pathway.

Credits=4	MZT 413 :Cell and Molecular Biology	No. of hours per unit/ credits
I	<p>1. Membrane Structure and Function Structure of model membrane, Lipid bilayer and membrane protein diffusion, Osmosis, Ion channels, Active transport, Membrane pump Cell-cell adherence, Gap junction, ECM, Integrin</p>	15
I	<p>1. Secretary Pathway: ER-structure (SER, RER), transport. Ribosomes, Polysomes, Free ribosomes, Membrane associated ribosomes and secretary pathway. Vesicles involved in intracellular transport.</p>	15
I	<p>1. Cellular respiration & degradation: Peroxisomes – structure and functions. Endosomes – late and early, Structure, Formation, Assembly & components. Lysosomes – Structure, Types, Function Proteasomes – Types structures, Assembly & functions. Mitochondria – Structure & Functions, Assembly components. Role of cyt.p.450 in detoxification (Xenobiotic Transformation)</p>	15

I	<p>1. Nuclear Components: Nucleus – EM. Structure. Nuclear envelope – structure & function. Chromosomes – Packaging of genome, genetic maps and nucleolus. Heterochromatin.</p> <p>2. Cell cycle division and signal transduction: Cell cycle – cyclins & cyclin dependent kinases & checkpoints. Cytoskeleton & intracellular movement – microtubule, MTOC. Micro filaments & intermediate filaments. G protein and G protein coupled Signal transduction pathway.</p>	15
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Course outcomes: Student will be able to:

1. Explain the models of membrane structure and diffusion of molecules passing through it.
2. Give original example of pattern of protein secretion and its intracellular transport through vesicles.
3. Demonstrate the structure and function of cell organelles.
4. Criticize importance of cell cycle, checkpoints and signal transduction pathway.

References:

1. Molecular biology of the Cell –Bruce Albert Pub. By Garland Pub. Inc.New York & London.
2. Lodish Berk, Matsudaira, Kaiser, Krleger (2004). Molecular Cell biology, W.,H. Freeman & Company, NewYork.
3. Gerald carp (2005), Molecular cell biology, John Wiley&Sons.
4. Avers C.J. (1986) Molecular Cell Biology, Addison-Westey, and Reading in Massachusetts.
5. Baserga, R (1985)/ latest edition) The Biology of Cell Reproduction. Harward University Press Cambridge, Massachuselts
6. Beck, F. and J.B. Lloyd (eds) (1974) The Cell in Medical Science, Academic Press, London.
7. Callan, H.G (1986) latest edition) Lampbrush Chromosomes Springer –verlag NewYork.
8. Chambliss, G (ed) (1980) Ribosanes – Structure, Function& Genetics University of Park Press,Baltimore.
9. Edmunds, L.N. (1984) latest edition- Cell Cycle Clock, Marcel Dekker, NewYork.
10. Edmunds, L.N. (1987) latest edition. Cellular & Molecular Basis ofBiological Clocks Springer – Verlag Berlin.
11. Gomperts, B.D. Plusma Membrance, Academic press, NewYork.
12. Henning, W. (1987) Latest edition Structure & Function of Eukaryotic Chromosomes Springer – Verlag, Berlin.
13. Moens, P.B. (1987) latest edition Meiosis Academic Press, Orlands, Florida, USA.

14. Nomura, M.A. Tissiers & P. Lengyel (1974) –Ribosomes Cold Spring Harbor
Laboratory Press, New York.

MZT 414 E1: Applied Entomology

Course objectives: Student should be able to:

1. Recite the anatomy of insects, its biology and control measures of insect pests.
2. Describe morphological characters, life cycle, damage and control of pests.
3. Make a model of lac culture, sericulture and apiculture cultivation and products used for economic purpose.
4. Criticize the various methods of pest control utilized in an IPM program.

Credits=4	MZT 414 E1: Applied Entomology	No. of hours per unit/ credits
I	<p>1. Study of generalized insect: Grass hopper (Morphology and Anatomy Brief Account) Identification, Characteristics, Life cycle Digestive System Reproductive system Damage and Control</p> <p>2. House hold pests: Cockroach, Ant, Cricket, Clothes Moth, Carpet beetle, Furniture beetle, Cigarette beetle, House hold hairy caterpillar, Silverfish, Book louse, Wasp.</p>	15
I	<p>1. Veterinary pests: Blowfly, Stable fly, Warble fly, Crew worm fly</p> <p>2. Forest Pests: Termites, <i>Batocera rufumacualata</i>, Sal bostrichid beetle.</p> <p>3. Medicinal Pests: Mosquitoes, Housefly, Bedbug, Sand fly, Human lice, Tse Tse fly,</p>	15
I	<p>1. 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 Pests of Mulberry.</p> <p>2. Cultivation practices in lac Lac insect- Taxonomy, Distribution and life history, Host plants and lac insects, Strains of lac insect and their propagation, Cultivation practices, Lac extraction Uses of Lac.</p>	15

I	<p>1. Industrial apiculture: Importance and Scope Bee keeping equipments Establishment, Management of apiary and inspection of bee colonies. Honey- harvesting, its constituents, and uses. Other products of honey bee</p> <p>2. Principles and methods of pest management Methods of pest management in residential places and public buildings, Insecticides for domestic use and their safety, Organic methods of domestic pest management. Integrated Pest Management : Cultural, Mechanical, Physical, Genetic and Legal control of Insect Pests Advances in Integrated Pest Management.</p>	15
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Course outcomes: Student will be able to:

1. Recite the anatomy of insects, its biology and control measures of insect pests.
2. Explain morphological characters, life cycle, damage and control of pests.
3. Make a model of lac culture, sericulture and apiculture cultivation and products used for economic purpose.
4. Compare the various methods of pest control utilized in an IPM program.

References:

1. K. P. Srivastava, (1996). A text book of Applied Entomology vol.2
2. Sathe T.V. (2009).A text book of Forest Entomology –
3. Sathe T.V. and Jadhav A.D., (2001) .Sericulture and Pest Management
4. Sathe T.V., (1998), Sericultural crop protection
5. Atwal A.S., (1993), Agricultural Pests of India and South East Asia.
6. Sathe T.V. and Awate M.R., (2009) Crickets and Household pests.
7. Smit G.S., (1960) Beekeeping in the tropics.
8. S. Singh, (1975) Beekeeping in India,. ICAR, New Delhi,
9. Ullal and Narsimhanna, (1981) A handbook of practical Sericulture, CSB,
10. K. P.Srivastava. A text book of applied entomology

MZT 414 E2: Histology and Histochemistry

Course objectives: Student should be able to

1. Describe the instrumentation required in histology.
2. Explain techniques and stains used in histology.
3. Criticize structure of cell and tissue.
4. Demonstrate glycosaaminoglycans in histochemical techniques.

Credits=4	MZT 414 E2: Histology and Histochemistry	No. of hours per unit/ credits
I	<p>1. Tools in histology: Principles, design and functioning of microtomes, Automated microtomes, 1.3 Ultra microtome, 2. Cryostat, 3. Problems and troubleshooting</p>	15
I	<p>1. Techniques in histology: Sample preparation, Obtaining tissue samples, Handling reagents. 1.4. Fixatives types of fixatives and effect on tissue processing of fixed samples, Dehydration - procedure and significance, Embedding, Block making, Staining (staining methods histochemical and immunohistological methods), 2. Dyes and dye binding reactive groups 3. Mordants and mordanting 4. Temporary and permanent preparations 5. Whole mount preparation</p>	15
I	<p>1. Fundamentals of histology in vertebrate: Epithelial, connective, muscular, nervous and other specialized tissues in mammal (Rat/mice). Composite illustration of a cell, its cytoplasm and its organelles. Internal and external morphologies of ciliated and non-ciliated epithelium. Junctional complex between epithelial cells. Basal regions of epithelial cells.</p>	15

	1.6 Basal region of an ion-transporting cell.	
I	1. Fundamentals of histochemical techniques: Principle and practice Detection of glycogen Detection of Neutral and acid mucopolysaccharide, Detections of carboxymucins Detections of sialomucins Detection of proteins Detection of specific and nonspecific lipids	15

Course outcomes: Student will be able to

1. Describe instrumentation required in histology.
2. Explain techniques and stains used in histology.
3. Criticize structure of cell and tissue.
4. Demonstrate glycosaaminoglycans in histochemical techniques.

References:

1. Text book of Histology Roland lesson DL. WB Saunders Company, Tokyo.
2. Histology: Roland lesson and Thomas Leesan WB Saunders company Co., Canada
3. Histochemistry Vol. I II III A G E pearse Churchill Livingstone NY ZY 404 –
Histology and histochemistry (i) Enzyme detection: acid phosphatase, alkaline phosphatase, esterases (ii) Nucleic acid staining: methyl green, pyronine, feulgen stain (iii). Study of different types of tissue with help of permanent slides (iv) Effect of fixatives, fixation of tissues (v) Block preparation and sectioning (vi) Mucopolysaccharide staining, AB pH 1.5, 2.5 (vii) Proteins (basic mellrg) and lipid staining by sudan black ,(viii) Comparative study of effect of fixative on a given tissue, (ix) Effect of fixatives on tissue sections- liver
4. DiFiore's Atlas of histology with functional correlation, Victor P. Eroschenko 12th edition, 351 West Camden Baltimore, MD 21201

MZT 415: Research Methodology

Course objectives: Student should be able to:

- 1 Understand the different types of research work.
2. Present the research work scientifically.
3. Memorize the concept of Literature review.
4. Develop technical and scientific language.

Credits=4	MZT 415: Research Methodology	No. of hours per unit/ credits
I	<p>1. Concept of Scientific Research: Meaning of Research; Objectives of research, Motivation in research; Types of research (Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, Empirical and other types) Research methods, Experimental design, Research process : Steps of research process (formulation of problem, literature survey, Developing working problem, designing methodology of data collection, Analysis of Data and its presentation) Concept of good research.</p>	15
I	<p>1. Literature Survey and Problem Definition: Need of Reviewing Literature, purpose of Literature survey Literature Search Procedure, Sources of Literature, (SciHub, Pubmed, Google Scholar) Documentation and management of bibliography with softwares (e.g. EndNote, Mendeley etc.). Problem definition</p> <p>2. Planning of Research: Formulation of the Selected Problems, Hypothesis formation, Reasons for undertaking the problem Research Design/Plan.</p>	15
I	<p>1. Research communication & presentation: Scientific language and scientific writing Structures of Research proposals, Synopsis writing, review article writing,</p>	15

	<p>research paper (manuscript) (Abstract, Introduction, Review literature, methodology, Results, Discussions, Summary and Conclusion, Bibliography etc), research project writing 1.8 Presentations of research: Graphical, Tabular, Animation, Power point 2. Intellectual Property Rights, 3. Introduction to Patents 4. Plagiarism in research (Software used in plagiarism checking) 5. Terms related research (ISSN, ISBN, DOI, impact factor, citation index, H index, I index)</p>	
I	<p>1. Ethical issues and bio-safety regulation: DBT Guidelines for Bio-safety, 2. Ethics in use of Experimental animals: Institutional Animal ethics committee, CPCSEA guidelines for animal experimentation, 3. Animal Handling 4. Layout of animal house 3. Biodiversity laws in research: Guidelines and regulations of Bioresources utilization for commercial and research purpose. The Biological Diversity Act, Wildlife (Protection) Act, Forest (Conservation) Conservation Act.</p>	15

Course outcomes: Student will be able to

1. Design a research framework.
2. Develop soft skills in compilation and presentation of their research work.
3. Prepare a draft research/ review article based on a Literature Review.
4. Draw a layout of animal house.

References:

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.
5. Rastogi, (2008), Fundamentals of Biostatistics, ANE Books
6. Sharma, (2008), Text Book of Biostatistics-I&II, Discovery Publishing
7. Snedecor & Cochran,(1968), Statistical Methods, Oxford & IBH
8. Barnes & Gray, (2003), Bioinformatics for Geneticists. Wiley
9. Campbel, (2006), Discovering Genomics, Proteomics and Bioinformatics. LPE
10. Hunt & Livesey, (2006) Functional Genomics. Oxford

11. Lesk, (2006), Bioinformatics 2/e. Oxford
12. Mount, (2006), Bioinformatics 2/e. CBS
13. Westhead et al, (2003), Bioinformatics Instant Notes. Viva Books (Indian ed.)

M.Sc.Part-I, Sem-I
MZP 416 Practical Course
(Based on MZT 411, 412, 413 courses)

Course objective: Student should be able to:

1. Classify specimens from different classes or phylum.
2. Analyze different physicochemical parameter of water.
3. Categorize different types of glycosaminoglycans from tissue.
4. Demonstrate various types of nucleus from WBCs and liver

Credits=2	MZP 416 Practical Course (LAB-I)	No. of hours per unit/ credits
II	<ol style="list-style-type: none"> 1. Study of museum specimens and slides invertebrate's phyla & chordates phylum (one representative from each class) for biosystematics & biodiversity. 2. Identification of insects/ fish/amphibian with the help of preserved specimens / models /pictures) with the help of keys up to family. 3. Methods of collection and preservation of animals. 4. Study of endangered species. (Models, pictures, charts.). 5. Study of adaptations in animals from Pisces, amphibian, reptilian, birds & mammals (2-3 examples from each). 6. Study biodiversity of platue by Quadrate & transect method, Shannon index and Simpsons index 7. Visits to sanctuaries / National parks to study wild life management and visit to ZSI. 8. Study of inter relationships in animal - parasitism, symbiosis, commensalisms (2-3 examples from each). 9. Study of ecosystem (Pond, grassland, forest) 10. Qualitative and quantitative estimation of Zooplanktons 11. Determination of DO and CO₂ from given water sample. 12. Determination of Hardness from fresh water and sewage. 13. Determination of Alkalinity from fresh water and sewage water. 14. Determination of COD/ BOD of fresh and sewage water. 	60

	<p>15. Demonstration of Glycosaminoglycans in the extracellular material using,</p> <ol style="list-style-type: none"> a. AB-1 b. AB-2.5 c. PAS d. AF +AB 2.5 (Sialic Acid) <p>16. Demonstration of nucleus from WBCs / Liver by basic dyes (Toludene Blue, Hematoxylene, Giemsa's, Leishman)</p> <p>17. Demonstration of nucleus by Feulgen reaction- Effect of temperature, time, concentration.</p> <p>18. Lysosome demonstration (Acid phosphatase and any other method)</p> <p>19. Effect of tonicity of solutions on plasma membrane – Isotonic, Hypotonic, Hypertonic</p> <p>20. Demonstration of structure of cell with the help of electron microscope</p>	
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Course outcomes: Student will be able to:

1. Classify specimens from different classes or phylum.
2. Analyze different physicochemical parameter of water.
3. Categorize different types of glycosaminoglycans from tissue.
4. Demonstrate various types of nucleus from WBCs and liver

SEMESTER II

MZT 421: Physiological chemistry

Course Objectives: Student should be able:

1. Understand biochemistry of carbohydrates, protein and lipid.
2. To introduce structure, function and organization of various bio-molecules present in the living cells.
3. Students know the structure and properties of macromolecules that act together to maintain and perpetuate the living systems.
4. Understand the structure and function of nucleic acid

Credits=4	MZT 421: Physiological chemistry	No. of hours per unit /credits
I	1. Principles of Biological chemistry- Principles of biophysical chemistry (pH, buffer, reaction kinetics dissociation and association constants) Structure of atoms, Molecules Chemical bonds, Vander Waal's electrostatic, Hydrogen bonding and hydrophobic interactions. Thermodynamics, Concept of free energy, Enthalpy and Entropy, 2. Water: Structure physicochemical properties, Energy rich bonds. 3. Basics of solution preparation: Molarity, Molality, Normality, W/V, % solution, ppm, Stock dilution.	15
I	1. Carbohydrates – Structure, classification function, 2. Carbohydrate metabolism: Glycolysis, TCA cycle, Electron transfer and ATP generation, Bioenergetics of ATP cycle Glycogenesis, Glycogenolysis Gluconeogenesis Pentose phosphate pathway.	15

I	<p>1. Proteins- Primary structure of proteins Classification Functions,</p> <p>2. Protein metabolism Transamination and deamination Urea cycle Conformation of proteins and, Reverse turn Ramachandran plot.</p> <p>3. Nucleic acids: Primary structure of nucleic acids, DNA, RNA structure and functions Biosynthesis of nucleotides.</p>	15
I	<p>1. Lipids- Classification Structure of fatty acid and triacylglycerol Function,</p> <p>2. Catabolism of fatty acid: Beta oxidation, Significance of beta oxidation,</p> <p>3. Biosynthesis of saturated and unsaturated fatty acids, 4. Biosynthesis of triglyceride, 5. Biosynthesis of membrane phospholipids, 6. Biosynthesis of cholesterol, 7. Steroid hormones- (Synthesis, transport, mechanism of action)</p>	15

Course Outcomes: Students will able to:

1. Acquired on the structure and function of different biomolecules would enable the students to consolidate their focus on understanding various metabolic pathways crucial for the sustenance of living systems.
2. Classify the metabolic pathways and their role in human bodies.
3. Explain the micro and macromolecules and their concern diseases.
4. Apply knowledge and importance of water for living system.

References:

1. Arthur Anderson, Chapman & Hall, (1947) Essentials of physiological chemistry, (New York, Wiley, London 395 pp.
2. Harold Harper, (1979), Review of physiological chemistry.
3. Peter Karlson (1965) - Introduction to Modern biochemistry, New York and London, Academic Press,403 pp.
4. Mahler H and Cordes E – Biochemical chemistry
5. David Nelson and Michel Cox, (2013), Lehninger’s Principles of Biochemistry 6th edition, W. H.Freeman Publisher, 1158 pp.
6. Francis Reithel, (1967) Concepts in Biochemistry, McGraw-Hill, 414 pp.
7. George Bell, J Norman Davidson and D Emsile Smith (1952) Text book of physiology andbiochemistry, Edinburgh: E & S. Livingstone Ltd. 1160 pp.
8. Mitlon and Toporely- Essentials of biochemistry

MZT 422: Tools and Techniques in Zoology

Course Objectives: Student should be able to:

1. Define the terms Central tendency, correlations, regression and analysis of variance.
2. Understand how to apply testing hypothesis, Probability distribution, student t-test and Chi-square test.
3. Memorize various techniques to separate molecules.
4. Remember various instruments and their applications in biology.

Credits= 4	MZT 422: Tools and Techniques in Zoology	No. of hours per unit/credits
I	1. Introduction, Application in Biology. 2. Measurement of Central tendency. 3. Measures of dispersion. 4. Correlation- Types and methods of correlation. 5. Regression- Regression lines and coefficients. 6. Analysis of Variance (ANOVA).	15
I	1. Probability- Introduction, addition and multiplication theory. 2. Probability distribution- Binomial, Poisson and Normal. 3. Testing of hypothesis. Tests of Significance. Null hypothesis. Alternative hypothesis. Level of significance. 4. Student t- test. 5. Chi- square test (X ²). 6. Confidence interval.	15
I	1. Separation techniques: Chromatographic techniques Chromatography theory & practices, Molecular Sieve chromatography, Affinity chromatography, Ion exchange chromatography, HPLC, GLC, Thin layer chromatography. 2. Electrophoretic techniques General principles, Support media, Electrophoresis of proteins and nucleic acids, Isoelectric focusing. 3. Centrifugation	15

	Density gradient centrifugation Applications	
I	1. Analytical instruments and their applications in Biology: Spectroscopy Spectrophotometry, Spectrofluometry, NMR, ESR. 2. Microscopy, Phase contrast microscope, Fluorescence microscope, Electron Microscope (SEM & TEM). 3. Radiometry &Immunochemical techniques. Immunoprecipitation, Labelling antibodies, Immunoblotting, Immunoassays Immunohisto /cytochemistry.	15

Course Outcomes: Students will be able to:

1. Identify appropriate tools for diverse types of data, and explain their theoretical fundamentals.
2. Criticize analytical methods, models and theories used in published research, and identify, where relevant, more appropriate alternatives.
3. Apply and extend analytical methods, models and theories to biological datasets.
4. Analyze skills of separation technique, analytical instrumentation and their applications.

References:

1. Gupta S. C. Fundamentals of Statistics-
2. Datta A. K Basic Biostatistics and its applications-
3. Parihar and Parihar. Biostatistics and Biometry-
4. C. B. Gupta. An Introduction to statistical Methods-
5. Wilson and Walker Practical Biochemistry By
6. Cooper Cell : A molecular approach
9. Lodish et al. Molecular Biology of the Cell

MZT 423: Elements of physiology

Course Objectives: Student should be able to..

1. Understand concepts of mechanisms and functions of digestive system.
2. Discuss the physiology and basic regulatory concepts related to the respiration.
3. Explain circulatory system and blood clotting mechanism.
4. Remember the diagrammatic representation of excretory system and nephron.

Credits=4	MZT 423: Elements of physiology	No. of hours per unit/credits
I	<p>1. Gastrointestinal Physiology Functional anatomy of gastrointestinal tract Gastrointestinal tract associated glands (Liver, Pancreas and salivary gland) with their control mechanism Digestion and absorption in gastrointestinal tract Dietary balance, Regulation of feeding, Obesity and starvation, BMR, Vitamins and their role in metabolism</p>	15
I	<p>1. Physiology of Respiration: Mechanism of breathing and pulmonary ventilation Pulmonary volumes and capacities Physiology of gas exchange Regulation of respiration</p>	15
I	<p>1. Physiology of Circulation: Body fluids, blood coagulation and homeostasis Blood groups and blood transfusion Cardiac muscles and cardiac cycle Control of excitation and conduction in heart Normal electrocardiogram</p>	15
I	<p>1. Physiology of Excretion: Functional anatomy of the kidneys Mechanism of urine formation Regulation of urine formation, Process of micturition and diuretics 2. Nerve Physiology Cerebrospinal fluid and brain metabolism. Conduction of nerve impulse Synaptic transmission 3. Endocrinology Pituitary - Structure and functions</p>	15

	3.2 Thyroid and Parathyroid - Structure and functions, 4. Bone marrow and erythropoiesis	
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Course Outcomes: Students will able to:

1. Explain concepts of mechanisms and functions of digestive system.
2. Describe the physiology and basic regulatory concepts related to the respiration.
3. Interpret the normal ECG
4. Draw the diagrammatic representation of excretory system and nephron.

References:

1. Gordon Shepherd, (1987) Neuro Biology, (New York Oxford University Press 774 pp.
2. J. Willis Hurst, et al (1990), The Heart, 7th ed. New York McGraw- Hill Book Co. 2274pp.
3. Eugene Renkin and Charles, (1988) Michel Hand Book of Physiology Vols. Circulation. OxfordUniversity Press, 1124pp.
4. Arthur Gayton et al., (1972) Circulation Overall regulation, Annual Review Physiology, 34:13.
5. Arthur Gayton, (1980) Arterial pressure & Hypertension Philadelphia.
6. Norman Kaplan et al, (1989) The Kidney in Hypertension (Perspectives in hypertension vol.2)(New York. Raven Press,). Pages 46-51.
7. Arthur Gayton et al, (1975) Dynamics & Control of the Body fluids Philadelphia, (W.B. Saunders,Co.).
8. Barry Brenner et al. (2006), The kidney 3rd ed. Philadelphia, W.B. Saunders Co. 2080 pp.
9. Vernon Brooks, (1986) The neural Basis of motor control New York, Oxford University Press,.
10. Leonard Johnson, et al (2006), Physiology of the gastro intestine tract, New York Raven press, 2080 pp.
11. James Thompson et al (1987) (eds) Gastrointestinal Endocrinology. New York McGraw Hill bookco.
12. Kritchevsky, Dvaid, Nair, Padmanabhan, Setchell, (1988), The Bile Acids (New York PlenumPub. Corp 604 pp.
13. Helen Guthrie, (1989) Introductory Nutrition 7th ed. Times Mirror/ Mosby College Publishing, StLouis, 289-331.

MZT 424 E1: Biology of Parasites

Course Objectives: Student should be able to..

1. Define animal association, host and interrelationship between host and parasite
2. Describe the term vectors and arthropod vector of medical and veterinary importance.
3. Remember protozoan , helminthic parasite and their diseases
4. Criticize the life cycle, mode of transmission and control measures of different parasite.

Credits=4	SEMESTER-II MZT 424 E1: Biology of Parasites	No. of hours per unit/credits
I	1. Animal association, 2. Types of Parasites, 3. Types of Hosts, 4. Interrelationship between host and parasite responses 5. Hosts to parasitic infection, 6. Mode of transmission of parasite, 7. Host specificity 8. Parasitic adaptation	15
I	1. Vectors, Definition, types, Epidemiological consideration, Relationship of vertebrate, pathogen to vector immunology, Physiology of vector, Population studies and effectiveness of vector. 2. Arthropod vector of Medical and veterinary importance and control Human louse, Triatomine bugs, Black flies, Sand flies, Mosquitoes, House fly, Rat flea, ticks, mites Horse fly Tsetse fly, Stable fly	15
I	1. Study of parasites from Protozoa <i>Trypanosoma gambiense</i> <i>Leishmania donovani</i> Intestinal flagellates <i>Giardia lamblia</i> <i>Trichomonas</i>	15

	2. Study of parasites from Cestoda: <i>Diphilabothrium latum</i> Echinococcus	
I	1. Study of parasites from Trematoda: <i>Schistosomo haematobium</i> <i>Faciola hepatica</i> 2. Study of parasites from Nematoda: <i>Wucheria bancrofti</i> <i>Ancylostoma duodenale</i> <i>Strongyloides stercoralis,</i> <i>Entrobilus vermicularis</i> 3. Parasitic zoonosis (Monkey pox, Nipah)	15

Course Outcomes: Students will be able to:

1. Discuss animal associations for living in nature, host parasite interaction and their types.
2. Classify the vectors and disease and control measures by the vectors.
3. Draw the diagram of cestodes, trematodes, nematodes and their life cycle.
4. Differentiate the life cycle, mode of transmission and control measures of different parasite.

References:

1. Ramnik Sood, Parasitology, (C.B.S. Publisher, New Delhi –2019) 344 pp.
2. Krishnadhan Chatterjee, Parasitology Protozoology and Helminthology, 13Edition (C.B.S.Publisher, New Delhi 2019) 304 pp.
3. Leslie Chapell, (1979) Physiology of parasites, John, Willey & Sions N.Y.
4. Elmer Noble and Glenn Noble, (1982) The Biology of Animal Parasites, 2nd Ed. Lea & Febieger U.S.A.
5. Clark Read, (1970) Parasitism & Symbiology, Ronald Press New York.
6. Gerald Schmidt, Larry Robert, (2009) Foundation of Parasitology, 8th Ed. McGraw Hill Companies, 683 pp.
7. Derek Smyth, (1997) Introduction Animal Parasitology, 2nd Ed. Johns Willey Sons New York.
8. White field P. J. (1977) The Biology of parasitism and introduction to the study of associate organism by University Parks Press Baltimore.
9. Souls E.J.L 1969 Helminths, Arthropods & Protozoo of domesticated Animals. ELBSpublication London Ed.
10. S.S. Kelkar and Rohini S. Kelkar, Parasitology
11. Chandler and Chands, A Text book of Parasitology by Bombay popular prakashan.

MZT 424 E2: General Endocrinology

Course Objectives: Student should be able to...

1. Understand invertebrate endocrinology.
2. Describe the various endocrine glands and their secretion.
3. Recognize hormonal regulation of endocrine glands.
4. Criticize the pathophysiology of hormones in mammals.

Credits=4	MZT 424 E2: General Endocrinology	No. of hours per unit/credits
I	<p>1. Invertebrate endocrine systems: Insect– Anatomical organization, Structure and chemistry of hormones. Neuroendocrine control of metamorphosis Endocrine Control of reproduction Endocrine Control of diapause 2. Pheromones in insects.</p>	15
I	<p>1. Vertebrate endocrine systems (Human): Autocrine, paracrine and endocrine secretions - an overview of mammalian endocrine system. Hypothalamus- structure and functions, Hypothalamo-hypophysial portal system, Regulation of hypophysial secretions. 2. Pituitary gland (Hypophysis)- Structure and functions. 2.2 Pathophysiology: Hyperpituitarism (Gigantism, Acromegaly) Hypopituitarism (Sheehan's and Simmonds Disease, Dwarfism, Diabetes insipidus)</p>	15
I	<p>1. Thyroid gland & parathyroid gland, Structure and functions. Pathophysiology Hyperthyroidism (Grave's disease, Goiter, Exophthalmia) Hypothyroidism (Cretinism, Myxedema) 2. Adrenal gland Structure and functions. Pathophysiology Hyperadrenalism (Cushing's syndrome, Conn's syndrome) Hypoadrenalism (Addison's disease, hypoadosteronism) 3. Pancreas Structure and functions. Pathophysiology (Diabetes mellitus, Insulinoma)</p>	15

I	<p>1. Mechanism of hormone action in mammals (Human): Types of hormone receptors (membrane bound cytoplasmic and nuclear receptors) regulation of receptor number, signal transduction- secondary messengers, cyclic AMP, prostaglandin, Calmodulin mediated pathways, genomic mechanism of hormone action- thyroid and steroid hormones, termination of hormone action.</p>	15
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Course Outcomes: Students will be able to:

1. Describe invertebrate endocrinology.
2. Enlist the various endocrine glands and their secretion.
3. Demonstrate hormonal regulation of endocrine glands.
4. Differentiate the pathophysiology of hormones in mammals.

References:

1. Bentley, P.J.(1994) Comparative vertebrate endocrinology –III Ed. Cambridge Univ. Press (NY)
2. Chandra. S. Nagi : Introduction to Endocrinology PHI (New Delhi)
3. Degroot. L.J. and Neill, J.D. (2001) Endocrinology-IV Ed, Vol. I-III. W.B. Saunders company (Ed)
4. Modern entomology: D. B. Tembare 2nd revised edition, Himalay publication
5. Highman and Hill (1972) Comparative Endocrinology of Invertebrates
6. Human physiology- Guyton and Hall.
7. Mandal. A. (1994) Handbook of Neuroendocrinology, EMKAY publications
8. Nelson. R.J. (1995) An Introduction to behavioural endocrinology Sinauer Associates, Inc.
9. Nooris. D.O. (1996) Vertebrate endocrinology IIIrd Ed., Academic Press
10. Pickford G.E & Atz W.J. (1957) The Physiology of Pituitary gland of fishes (Zoological Survey; NewDelhi)
11. Turner. C.D. and Bugnara.J.T (1976) General Endocrinology., W.B. Saunder
12. Zarrow M.X and McCarthy. J. L. (1964) Experimental endocrinology (Academic Press; New York).
13. Textbook of Pathology., (2013) Harsh Mohan, 7th Edition.

MZT 425: RESEARCH PROJECT

Credits 4	MZT 425: RESEARCH PROJECT	No. of hours-60
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M.Sc.Part-I, Sem-II
MZP 426 Practical Course
(Based on MZT 421, 422, 423 courses)

Course Objectives: Student should be able to...

1. Describe endocrine gland and their role in Physiology.
2. Differentiate types of blood cells
3. Estimate total amount of protein, lipid, glycogen, cholesterol and vitamin C from sample.
4. Apply the knowledge of biostatistics in arithmetic calculations

Credits=2	MZP 426 Practical Course (LAB-II)	No. of hours per unit/credits
II	<ol style="list-style-type: none"> 1. Estimation of glycogen by any suitable method 2. Estimation of lipids by Bernes and Blackstock method. 3. Estimation of Ascorbic acid by Vitamin C tablet. 4. To prepare solution of given concentration change in normality/Molarity 5. Prepare phosphate buffer of known pH - measurement of pH of lemon juice, urine and serum. 6. To estimate free amino acids by Ninhydrin method. 7. To estimate protein content by Lowry's method. 8. Separation of amino acids by TLC / paper chromatography method. 9. Separation of nuclei by differential centrifugation 10. Example based on Central tendencies. 11. Examples based on Chi-square test & student t-test. 12. Examples based on regression & Correlation coefficient. 13. Examples based on probability & ANOVA. 14. Demonstration of ANOVA, Student t Test, Regression, hypothesis testing and P value using computer application or software. 	60

	<p>15. Determination of bleeding time and clotting time</p> <p>16. Estimation of Haemoglobin (Hb) concentration and oxygen carrying capacity</p> <p>17. Enumeration of Red blood corpuscles (R.B.C) & Erythrocyte sedimentation rate (E.S.R)</p> <p>18. Enumeration of white blood corpuscles (W.B.C) and differential count of W.B.C.</p> <p>19. Detection of digestive enzymes (any suitable enzyme)</p> <p>20. Microanatomy of Endocrine glands</p>	
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Course Outcomes: Students will be able to:

1. Describe endocrine gland and their role in Physiology.
2. Differentiate types of blood cells
3. Estimate total amount of protein, lipid, glycogen, cholesterol and vitamin C from sample.
4. Apply the knowledge of biostatistics in arithmetic calculations

References:

1. Ramesh Gupta and S. (2013), Bhargava, Practical Biochemistry, Fifth Edition, (CBS Publishers & Distributors,).
2. John Walker and Keith Wilson, (2005), Practical Biochemistry: Principles and Techniques, Cambridge University Press, 807 pp.
3. David Plummer, (2017), an Introduction to Practical Biochemistry, Third Edition, (McGraw Hill Education Pvt Limited,).
4. Dnyaneshwar Tembhare, (2010), Techniques in Life Sciences, First Edition, (Himalaya Publishing House Pvt. Ltd.) 463 pp.
5. B. Antonisamy, Prasanna Premkumar and Solomon Christopher, (2017), Principles and practice of Biostatistics, (Elsevier India,) 390 pp.