

Dr. HOMI BHABHA STATE UNIVERSITY, MUMBAI

**The Institute of Science,
15, madam Cama Road, Fort,
Mumbai – 400032**

Program: M.Sc.

Course: Zoology

Syllabus for Semester I & II

**(Choice based credit system with effect from the academic
year 2021-2022)**

M. Sc. Zoology Part I Sem. I & II

PREAMBLE

The proposed curriculum is framed with the view to make it more contextual and cater to the needs of society and nation. An attempt is made to elevate the syllabus to International levels, so as to facilitate easier transitions for Post Graduate Courses and Job prospects overseas.

The class-wise syllabus committees were constituted in accordance with inclusive policy of the BOS, with experienced staff members and providing faculty at large, exposure to work on syllabus and shape the subject which will go a long way ahead in future.

The committee examined the lacunae of the syllabus and after analyzing other curricula of existing universities in respective subjects in terms of content, relevance, quality and pattern of teaching and examination has synthesized the present proposal. After guidance from senior faculty, feedbacks from the core faculty, intensive discussions were done and the syllabus was suitably finalized. The Zoology department imparts postgraduate courses with major specialization in Oceanography and Endocrinology .The syllabus also includes papers in Biochemistry, Physiology, Developmental biology, Research methodology, Systematics and classification etc. A holistic approach includes providing training via workshops, visits to Institutions, field visits and educational tours.

The CBCGS pattern provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/ skill based courses. These elective/skill based courses like Sericulture, Biodiversity, Patent and IPR, and Parasitology will help to build a bridge between students and their future mentors from industry.

As per the guide lines of UGC for discontinuation of dissection of live animals in the laboratory experiments in Zoology/ Life Sciences at UG and PG levels, an expert committee was constituted i.e. Institutional animal ethical committee (IAEC) under the purview of Committee for Purpose of Care and Supervision of Experimental Animals (CPCSEA), Reg.no.1961/GO/Re/S/17/CPCSEA dated 25.04.2017 to look into the issue of using minimum bred animals for demonstration by the respective faculty.

In accordance with the deliberations in the meeting, draft syllabus for M.Sc. Semester-I and Semester II in Zoology, to be implemented in the Choice based Credit Based Semester and Grading System, was prepared by the committee under the guidance of core committee. The draft was

circulated among the heads and senior teachers of the Department of Zoology for approval and suggestions.

INTRODUCTION OF THE PROGRAMME COURSE

This program is intended to develop aptitude for learning about the biology and significance of fauna ranging from single cell to multi-cellular systems and an in-depth knowledge of the diversity in form, structure and habits of invertebrates and vertebrates along with the understanding of the evolutionary tree.

The course will educate the student on the fundamental structure, biochemistry and function of the cell and familiarize them with conventional organ system of easily available animals.

The students will get an exhaustive knowledge of the principle of developmental biology which will provide him a bird's eye view of sophisticated embryological techniques. Apart from the classical topics in animal sciences this syllabus covers various topics on agro based courses like, Sericulture, to generate employments and entrepreneurship for the students.

This program through the dissertation work helps the students in understanding the basic principles of nature and also gives hands-on experience to the students on experimenting with nature /animals and thereby enables the students to develop aptitude for research in various allied fields of animal sciences.

Learning Outcome:

Students on this course will be familiar with the wider concepts of biodiversity, science, evolutionary biology and genomics. Most importantly, students will gain the abilities to work as an independent scientist and researcher, to be able to solve questions about the future of biodiversity and to communicate them to peers and the public.

Students will learn the practical and conceptual issues in taxonomy, biodiversity and evolutionary biology starting from phylogenetic principles. They will learn the quantitative skills in morphological and molecular techniques of taxonomy and systematics,

They will learn the main stages of development common to most multicellular organisms and the main anatomical changes that occur during development as a result of cellular behaviours .

Further they will understand the structure, metabolism of macromolecules and will learn the regulation and disorders of metabolic pathways and will gain proficiency in laboratory techniques in both biochemistry and molecular biology, and will be able to apply the scientific method to the processes of experimentation, formulate scientific hypotheses and design an appropriate research plan for testing this hypothesis.

Also they will learn scientific communication, including presentations to scientific conferences, writing scientific reports and journal publications, research methodologies, effective communication and skills of problem solving methods.

Under the Interdepartmental courses in Parasitology the students will learn the insight into parasites population ecology, including factors affecting infection pressure and spread rate of a parasite in a host population.

They will understand how important parasitic properties are influenced by evolutionary processes, environmental health, and the fundamental and applied problems that are of compelling societal and scientific interest.

In Generic elective –Biodiversity and Conservation the student will understand biological diversity and will learn the protection of endangered species by understanding environmental conservation processes, its importance and monitoring changes due to both anthropogenic and natural factors thus contributing in pollution control.

Under Ability enhanced courses the students will gain knowledge in Agro based Small Scale industries like Sericulture, which will help them to become entrepreneurs in these fields. Also the course in IPR will enable the students to acquire Intellectual Property (IP) as a career.

Structure of the M.Sc. Zoology in HBSU

| SEM | Core Courses Credits: 4 | DSE/ID Credits: 4 | GE Credits: 2 | AEC Credits: 2 | SEC Credits: 4 | Non- CGPA | Total Credits |
|------------|--|---------------------------------------|--|----------------------------|---------------------------|------------------------------|--|
| I | MZOCC101 + MZOLAB101 Non-Chordata (Systematics and Functional Anatomy) | MZOID101 MZOLAB104 Parasitology | MZOGE101 Biodiversity and Conservation | MZOAE101 IPR and Patent | Nil | MOOC's and/or Co/Extra | CC: 4*3=12 ID: 4*1 =4 GE: 2*1= 2 AE: 2*1=2 Lab 2*4 = 8 Total = 28 |
| | MZOCC102 + MZOLAB102 Developmental Biology | | | | | | |
| | MZOCC103 + MZOLAB103 Research Methodology I | | | | | | |

| SEM | Core Courses Credits: 4 | DSE/ID Credits: 4 | GE Credits: 2 | AEC Credits: 2 | SEC Credits: 4 | Non-CGPA | Total Credits |
|------------|---|--|--------------------------|---------------------------|---------------------------|------------------------------|---|
| II | MZOCC201 + MZOLAB201 Chordates (Systematics and Functional anatomy) | MZOID201 + MZOLAB204 Histology and Histochemistry | Nil | Nil | MZOSE201 Sericulture | MOOC's and/or Co/Extra | CC: 4*3=12 ID : 4*1=4 SE: 4*1=4 Lab 2*4= 8 Total = 28 |
| | MZOCC202 + MZOLAB202 Biochemistry | | | | | | |
| | MZOCC203 + MZOLAB203 Research Methodology II | | | | | | |

Sem. I 2021-22
Scheme of marks

| Sr. No | Paper codes Theory/Practical | Subject | Credits | Teaching Scheme | | | | Examination Scheme | | | | | | | | |
|------------------------------------|---------------------------------|---|---------|-----------------|-------------------|---------------|------------------|----------------------|------------------------|-------------|--------------------|---------------|------------------------|-------------|--------------------|--|
| | | | | Theory Periods | Practical Periods | Total Periods | Duration in Hrs. | Theory | | | | | Practical | | | |
| | | | | | | | | Maxi. Marks (Theory) | Maxi. Marks (Internal) | Total Marks | Min. Passing Marks | Duration Hrs. | Max. Marks (Practical) | Total Marks | Min. Passing marks | |
| 1 | CC101 / LAB101 | Non-chordata (Systematics and Functional Anatomy) | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 2 | CC102 / LAB102 | Developmental Biology | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 3 | CC103 / LAB103 | Research Methodology – I | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 4 | ID101 / LAB104 | Parasitology | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 5 | GE101 | Biodiversity and Conservation | 2 | 2 | - | 2 | 2 | 30 | 20 | 50 | 20 | 1.5 | - | - | - | |
| 6 | AEC101 | IPR and Patents | 2 | 2 | - | 2 | 2 | 30 | 20 | 50 | 20 | 1.5 | - | - | - | |
| | | Total | 28 | 20 | 32 | 52 | 52 | 300 | 200 | 500 | 200 | 13 | 200 | 200 | 80 | |
| Grand Total Semester I: 700 | | | | | | | | | | | | | | | | |

Sem. II 2021-22
Scheme of marks

| Sr. No. | Paper codes Theory/Practical | Subject | Credits | Teaching Scheme | | | | Examination Scheme | | | | | | | | |
|-------------------------------------|---------------------------------|--|---------|-----------------|-------------------|---------------|------------------|----------------------|------------------------|-------------|--------------------|---------------|------------------------|-------------|--------------------|--|
| | | | | Theory Periods | Practical Periods | Total Periods | Duration in Hrs. | Theory | | | | | Practical | | | |
| | | | | | | | | Maxi. Marks (Theory) | Maxi. Marks (Internal) | Total Marks | Min. Passing Marks | Duration Hrs. | Max. Marks (Practical) | Total Marks | Min. Passing marks | |
| 1 | CC201 / LAB201 | Chordata (Systematics and Functional Anatomy) | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 2 | CC202 / LAB202 | Biochemistry | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 3 | CC203 / LAB203 | Research Methodology – II | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 4 | ID201 / LAB204 | Histology and Histochemistry | 6 | 4 | 8 | 12 | 12 | 60 | 40 | 100 | 40 | 2.5 | 50 | 50 | 20 | |
| 5 | SE201 | Sericulture | 4 | 4 | - | 4 | 4 | 60 | 40 | 100 | 40 | 2.5 | - | - | - | |
| | | Total | 28 | 20 | 32 | 52 | 52 | 300 | 200 | 500 | 200 | 12.5 | 200 | 200 | 80 | |
| Grand Total Semester II: 700 | | | | | | | | | | | | | | | | |

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| | Course Code: MZOCC101 | Course Title: Non-chordata (Systematics and Functional Anatomy) | |
| | Course Credit:4 | Total contact hours: 60 Hrs | |
| | <p>Course Outcome :</p> <ul style="list-style-type: none"> • The student will learn the patterns and processes of evolution above the species level, including modern taxonomy and also to identify the key components of scientific inquiry • The students will learn the Functional morphology which links up variation in phenotype to variation in musculo-skeletal function .They will understand the ecomorphology which links variation in ecology and the phenotype of an organism so that they will learn whole-animal performance in an ecological and evolutionary context. • Further the students will learn the animal diversity, including knowledge of the scientific classification and evolutionary relationships of major groups of animals and the relationships between structure and functions at different levels of biological organization (e.g., molecules, cells, organs, organisms, populations, and species) for the major groups of animals. Based on this they will be able to understand physiological adaptations, development, reproduction and behaviour of different forms of life. | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT 1:</p> <p>Animal diversity and principles of taxonomy:</p> <ol style="list-style-type: none"> 1. Principles of systematics, basic concept and types of taxonomy. 2. Modern methods of taxonomy, behavioural taxonomy, chemotaxonomy, molecular taxonomy, numerical taxonomy, Neo taxonomy and cytotaxonomy 3. Biosystematics of taxa based on Protostomes and Deuterostomes. 4. Taxonomic keys-Types of taxonomic keys, their merits and demerits, international code of zoological nomenclature, it's operative principles, interpretation 5. And application of important rules, zoological nomenclature, formation of names and various taxa. | | 15 Hrs. |

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| 2 | <p>Unit II</p> <p>Functional morphology of protostomes (Annelida, Arthropoda, Molluscs):</p> <ol style="list-style-type: none"> 1. comparative account of digestive Systems 2. Comparative account of circulatory systems 3. Comparative account of respiratory systems 4. Comparative account of excretory Systems 5. Comparative account of Nervous systems 6. Comparative account of reproductive systems. | 15 Hrs. |
| 3 | <p>Unit III</p> <p>Functional morphology of euterostomes (Echinodermata:Hemichordata):</p> <ol style="list-style-type: none"> 1. Comparative account of digestive systems 2. Comparative account of circulatory systems 3. Comparative account of respiratory systems 4. Comparative account of excretory Systems 5. Comparative account of nervous system 6. Comparative account of reproductive systems | 15 Hrs. |
| 4 | <p>Unit IV</p> <p>Minor phyla and phylogeny :</p> <ol style="list-style-type: none"> 1. Phylogenetic relationships of trochophore larva 2. Similarities and differences between annelids and molluscs 3. Phylogeny of Arthropods-monophyletic theory and polyphyletic theory 4. Affinities of Echinodermata with Hemichordata. | 15 Hrs. |
| | <p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Biology of Invertebrates; J.A.Pechenik, 4th Ed, Tata McGraw Hill Publication. | |

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| | <ol style="list-style-type: none"> 2. Invertebrate Zoology; E.L.Jordan and P.S.Verma, S. Chand & Company. 3. Analysis of Vertebrate Structure: Milton Hildebrand, Wiley International 4. Life of Invertebrates; Russell, W.D. Hunter, McMillan 5. Invertebrate Zoology: Bares, R.D., Saunders Publication. 6. PRINCIPLES OF ANIMAL TAXONOMY --G.G. Simpson 7. Animal Behavior Desk Reference:A Dictionary of Animal Behavior, Ecology and Evolution by Edward M. Barrows 8. Comparative Anatomy of Vertebrates Paperback – Import, 30 Apr 2015 by R. K. Saxena (Author), SumitraSaxena (Author) 9. Chordate Embryology Paperback – 1 Dec 2010 by Verma P.S. (Author), Agarwal V.K. (Author) –S.Chand publication 10. Animal Behaviour (Ethology) Paperback – 1 Dec 2010 by Agarwal V.K. (Author). 11. Organic Evolution (Evolutionary Biology) Paperback – 1 Aug 2017 by Veer BalaRastogi (Author) 12. Comparative Animal Physiology Hardcover – Import, 2 Jan 1992 by <u>Philip C. Withers</u> 13. Comparative Physiology: Primitive Mammals Paperback – Import, 4 Jun 2009 by Knut Schmidt-Nielsen (Editor), Liana Bolis (Editor), Charles Richard Taylor (Editor) 14. Conservation Biology: Foundations, Concepts, Applications Paperback – 6 Nov 2010 by <u>Fred Van Dyke</u> 15. Biology of Non-chordates Paperback – 17 Nov 2017 by <u>Fatik Baran Mandal</u> (Author) 16. Non-Chordates-I Paperback, by mohan p arora 17. Animal Diversity (Invertebrata&Chordata) Paperback – 2013 18. by A.Thangamani, S. Leelavathy, S. Prasannakumar, N. SoundaraPandian, T. Murugan, L.M. Narayanan, N. Arumugam N.C Nair (Author) 19. A Manual of Practical Zoology: Chordates Paperback – Jan 2010 by P S Verma (Author) 20. Non-Chordate (Invertibrate) Zoology Practical Paperback – 2009 by Pandey (Author), Shukla (Author) 21. Practical zoology by K.C. Ghode 22. Invertebrate practical zoology by S.S. Lal. | |
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| | Course Code: MZOLAB101 | Course Title: Non-chordata (Systematics and Functional Anatomy) | |
| | Course Credit:2 | Total contact hours: 60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | |
| 1 | <ol style="list-style-type: none"> 1. General organization of animals on the basis of coelom, symmetry Metamerism, grades of organization and cephalization. 2. Study of digestive system of earthworm, prawn*, <i>Pila</i>*, Loligo, starfish. 3. Study of excretory systems of earthworm, prawn*, <i>Pila</i>*, Loligo, starfish. 4. Study of nervous system of earthworm, prawn*, <i>Pila</i>*, Loligo, starfish, 5. Study of reproductive system of earthworm, prawn*, <i>Pila</i>*, Loligo. 6. Study of phylogenetic relationships within larval forms of Annelids, Arthropods, Molluscs, echinoderms. 7. Mounting of osphradium, radula and statocyst of <i>Pila</i>. 8. Local field visits in and around Mumbai/National Parks/Research Institutes/Museum, to explore various habitats and diversity. <p>(Note: * minimum animals to be used for dissection)</p> | | |

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| | Course Code: MZOCC102 | Course Title: Developmental Biology | |
| | Course Credit:4 | Total contact hours:60 Hrs | |
| | <p>Course Outcomes:</p> <ul style="list-style-type: none"> • Developmental Biology enquires about the fundamental processes that underpin the fertilization of an egg cell and its step-by-step transformation into the fascinating complexity of a whole organism. • Students learn best by doing and by having the opportunity to put what they have learned into practice. Therefore, using various model organism as a learning tool in Developmental Biology, students will learn how a cell behaves in response to an autonomous determinant or an external signal depends on the combination of transcriptional and posttranscriptional regulators, signaling pathway components, cytoskeletal elements, and other proteins and RNAs that it has synthesized earlier: i.e., on its developmental history. • Students will also understand that cells only express a proportion of their genome, and that differential gene expression underlies cell differentiation and any alteration in the entire process of development leads to devastating diseases. | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT I Basic concepts of Developmental Biology</p> <ol style="list-style-type: none"> 1. Types of Reproduction– Asexual and Sexual 2. Fertilization – Concept and Types 3. Mechanism of Fertilization <ol style="list-style-type: none"> 1. Capacitation of Sperm 2. Recognition of Sperm and Egg 3. Acrosome reaction 4. Activation of Egg 5. Fusion of Egg and Sperm cell membrane 6. Amphimixis | | 15 L |

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| | <p style="text-align: center;">UNIT II</p> <p>Fate mapping, Cell specification and Morphogenesis, post embryonic development:</p> <ol style="list-style-type: none"> 1. Cell division, cell differentiation, signalling, patterning, evolution of developmental patterns 2. Fate mapping and cell lineages; potency and commitment 3. Competence and induction 4. Mosaic and regulative development 5. Cell specification: <ol style="list-style-type: none"> 1) Autonomous specification 2) Conditional specification 3) Syncytial specification 6. Morphogenesis and cell adhesion: <ol style="list-style-type: none"> 1) Differential cell affinity 2) Cell Adhesion Molecules (CAMs): Cadherins and catenins. 3) Sorting out of embryonic tissues and cell recognition. 7. Postembryonic development: <p style="margin-left: 40px;">growth, cell proliferation, growth hormones; aging- genes involved in alteration in timing of senescence</p> | 15 L |
| 2 | <p style="text-align: center;">UNIT III</p> <p>Early embryonic development :</p> <ol style="list-style-type: none"> 1. Structure of the sperm and egg, cleavages and gastrulation, axes and germ layers 2. Development of <i>Caenorhabditis elegans</i> <ol style="list-style-type: none"> 1. Pattern of Cleavage 2. Anterior-Posterior Axis formation 3. Dorsal-Ventral Axis formation 4. Cell Specification (Autonomous and Conditional) 5. Process of Gastrulation 3. Early Development in <i>Drosophila melanogaster</i>: <ol style="list-style-type: none"> 1. Pattern of Cleavage 2. Blastulation 3. Process of Gastrulation 4. Anterior-Posterior pattern formation by morphogenetic protein gradient 5. Dorsal-Ventral pattern formation by morphogenetic protein gradient 7. Patterns of homeotic gene expression: 8. Homeo selector gene complexes (Hom-C , 9. homeotic gene complex) – Antennapedia and bithorax complexes and their functional domains, Realistor genes: <i>distal-less</i> and <i>wingless</i> genes. | 15 L |

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| 4 | <p>UNIT IV Regeneration & Medical implications</p> <p>1. Regeneration–</p> <ol style="list-style-type: none"> i. Epimorphic regeneration of reptile (salamander) limb morphallaxis ii. Regeneration in hydra; iii. Embryonic stem cells and their applications <p>2. Medical implications of developmental biology:</p> <ol style="list-style-type: none"> i. Genetic errors of human development- the nature of human syndromes– pleiotropy, genetic heterogeneity, phenotypic variability, mechanism of dominance; ii. Gene expression and human disease– <ol style="list-style-type: none"> a. Inborn errors of nuclear RNA processing, b. Inborn errors of translation; c. Teratogenesis environmental assaults on human development , teratogenic agents like alcohol, retinoic acid etc. | 15 L |
| | <p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Essentials of Developmental Biology – J.M.W. Slack 2nd Edition, Blackwell Publishing, 2006 2. Developmental Biology – Scott F. Gilbert – 8th Edition, Sinauer Associates Inc., 2006 3. Principles of Development – L. Wolpert – 4th Edition, Oxford University Press, 2011. 4. Modern Text Book of Zoology- Invertebrates by R.L .Kotpal, Rastogi Pub,10th Edn,2013. 5. An Introduction to Embryology by B.I.Balinsky, CBS college Pub,5th Edn,1981. 6. Biology of the Invertebrates by Jan A. Pechenik, Tata McGraw- Hill, 4th Edn,2000. 7. Invertebrate Zoology by P.S.Dhami and J.K.Dhami, S.Chand and Co.3rd Rev.Edn 8. Vertebrate Zoology by P.S.Dhami and J.K.Dhami, S.Chand and Co.3rd Rev.Edn 9. General and Applied Entomology by B.V.David and T.N.Ananthakrishnan, Tata McGraw- Hill, 2th Edn,2004. 10. Modern Entomology by D.B.Tembhare,Himalaya Publishing House,1st Edn,1997. References: 11. Essentials of Developmental Biology – J.M.W. Slack 2nd Edition, Blackwell Publishing, 2006 12. Developmental Biology – Scott F. Gilbert – 8th Edition, Sinauer Associates Inc., 2006 13. Principles of Development – L. Wolpert – 4th Edition, Oxford University Press, 2011. 14. Modern Text Book of Zoology- Invertebrates by R.L .Kotpal, Rastogi Pub,10th Edn,2013. 15. An Introduction to Embryology by B.I.Balinsky, CBS college Pub,5th Edn,1981. | |

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| | <p>16. Biology of the Invertebrates by Jan A. Pechenik, Tata McGraw- Hill, 4th Edn,2000.</p> <p>17. Invertebrate Zoology by P.S.Dhami and J.K.Dhami, S.Chand and Co.3rd Rev.Edn</p> <p>18. Vertebrate Zoology by P.S.Dhami and J.K.Dhami, S.Chand and Co.3rd Rev.Edn</p> <p>19. General and Applied Entomology by B.V.David and T.N.Ananthakrishnan, Tata McGraw- Hill, 2th Edn,2004.</p> <p>20. Modern Entomology by D.B.Tembhare,Himalaya Publishing House,1st Edn,1997.</p> | |
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| | Course Code: MZOLAB102 | Course Title: Developmental Biology | |
| | Course Credit:2 | Total contact hours:60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | |
| | <ol style="list-style-type: none"> 1. Culturing of <i>Paramecium</i> Sp. to study conjugation and binary fission. 2. To study development of <i>C. elegans</i>. 3. To study life cycle of Drosophila. 4. To observe stages of Tribolium or Sitophilus to understand indirect development in animals. 5. Study of regeneration in Hydra. 6. Isolation of limb-bud and its chorioallantoic grafting in chick embryo. 7. Observations : Permanent slides/photos/Charts/preserved specimens/Animal models for studying the developmental aspects: <ol style="list-style-type: none"> 1) Gemmule in sponge, 2) Triploblastic acoelomate (T.S. of body wall of Platyhelminthes), 3) Triploblastic pseudocoelomate (T.S. of body wall of Ascaris) 4) Triploblastic coelomate (T.S. of body wall of earthworm), 5) Planula larva (Coelenterata), 6) Mysis larva, 7) Tornaria (Hemichordata). 8) Chick embryo (24 hrs.). 9) Chick embryo (33 hrs.). 10) Chick embryo (48 hrs.). | | |

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| | Course Code: MZOCC103 | Course Title: Research Methodology – I | |
| | Course Credit: 4 | Total contact hours:60 Hrs | |
| | <p>Course Outcome : On successful completion of the course students will be able to:</p> <ul style="list-style-type: none"> • Search for, select and critically analyse research articles and papers • Prepare a literature review • Formulate and evaluate research questions • Develop a research proposal or industry project plan • Gain experience with instrument development and data collection methods. • Gain experience with ethics proposals. | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT I Good Laboratory Practices, laboratory equipment and their Techniques:</p> <p>1. Safety in laboratories :</p> <p style="padding-left: 40px;">i) General safety measures; personal protection; chemical hazards; spillage and waste disposal; first aid.</p> <p style="padding-left: 40px;">ii) Use, Care and Maintenance of common laboratory equipment: Microscope, pH meter, colorimeter/spectrophotometer, analytical balance, centrifuge, electrophoresis apparatus, glassware.</p> <p>2. Principles and applications of centrifugation:</p> <p style="padding-left: 40px;">i. Basic principles of centrifugation</p> <p style="padding-left: 40px;">ii. Low speed and high speed centrifuges</p> <p style="padding-left: 40px;">iii. Ultracentrifuge</p> <p style="padding-left: 40px;">iv. Application of centrifugation-preparative techniques</p> <p style="padding-left: 40px;">v. Analytical measurements</p> <p style="padding-left: 40px;">vi. Care of centrifuges and rotors.</p> <p>3. Principles and application of filtration, distillation and</p> | | 15 Hrs |

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| | <p>extraction:</p> <ol style="list-style-type: none"> i. Ordinary filtration under suction pressure ii. Fractional distillation iii. Steam distillation <p>4. Technique of extraction with solvents</p> | |
| 2 | <p>UNIT II</p> <p>Microscopy (Principles and applications) :</p> <ol style="list-style-type: none"> i) Light microscopy ii) Phase contrast microscopy iii) Fluorescence microscopy iv) Polarization microscopy v) Confocal scanning microscopy vi) Transmission electron microscopy vii) Scanning electron microscopy. viii) Specimen preparation for electron microscopy ix) New generation probe microscopy (e.g. Scanning Tunnelling and Atomic Force Microscopy) | 15 Hrs |
| 3 | <p>Unit III</p> <p>Principles and application of chromatography</p> <ol style="list-style-type: none"> 1. Planar chromatography (Paper and Thin layer): Preparation of stationary support, solvent, detection and measurement of components, applications. 2. Column chromatography: Packing and operation of column, loading the column, eluting the column, collection of eluent, detection of eluent, application. 3. Ion exchange chromatography: Ion exchange resins, selection of ion-exchanger, choice of buffers, preparation and use of ion-exchangers, storage of resins. | 15 Hrs |

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| | <p>4. Gel chromatography: Theory of gel filtration; physical characteristics of gel chromatography, chemical properties of gel, selection of gel, gel preparation and storage, operation of gel column, application.</p> <p>5. Affinity chromatography: Chromatography media, immobilized ligands, attachment of ligands to the matrix, experimental procedures and application.</p> <p>6. Gas chromatography (GC): Instrumentation, selection of operating conditions, analysis of data and application.</p> <p>7. HPLC: Instrumentation, selection of operating conditions, analysis of data and application.</p> | |
| 4 | <p>Unit IV Electrophoresis</p> <ol style="list-style-type: none"> 1. Theory of electrophoresis 2. Horizontal agarose gel electrophoresis 3. Vertical polyacrylamide gel electrophoresis 4. Pulse field electrophoresis 5. Capillary electrophoresis 6. Isoelectric focusing of proteins 7. Two dimensional electrophoresis | 15 Hrs |
| | <p>Suggested readings :</p> <ol style="list-style-type: none"> 1. Modern Experimental Biochemistry; 3rd Ed. Rodney Boyer, Pearson Education. 2. Principles and Techniques of Practical Biochemistry. Wilson and Walker, Cambridge Univ. Press. 3. Biological Science; 3rd Ed. D.J.Taylor, N.P.O.Green, G.W.Stou, Cambridge Univ. Press 4. Cell and Molecular Biology- Concepts and Experiments, Gerald Karp. John Wiley & Co. 5. Introductory Practical Biochemistry; S.K.Swahney, Randhir Sing. Narosa Publ. 6. An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGraw Hill | |

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| | <p>7. Practical Research Planning and Design; 2nd Ed. Paul D. Leedy. Macmillan Publ.</p> <p>8. Elementary Practical Organic Chemistry Part I: Small Scale Preparations 2nd Ed. Arthur I. Vogel. CBS Publ. and Distributors.</p> <p>9. Research Methodology. Methods and Techniques; C.R.Kothari. Wiley Eastern Ltd. Mumbai</p> | |
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| | Course Code: MZOLAB103 | Course Title: Research Methodology I | |
| | Course Credit: 2 | Total contact hours:60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| | <ol style="list-style-type: none"> 1. Identification of pictograms, symbols and signs of safety in laboratory practice. 2. Solutions and Buffers: Mode of expressing concentration of solutions- Molarity (M), Molarity (M), normality (N), Mass concentration, mass fraction, mass percentage or % (w/w), % by volume (v/v), parts per million (ppm) with practical exercises. Types of solutions- Stock solutions practical exercises. 3. Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter. 4. Determination of pKa of weak acid. 5. Identification of lipids in a given sample by TLC 6. Separation of pigments from leaves or flowers by adsorption column chromatography. 7. Separation of amino acids by ion exchange chromatography using cation exchanger. 8. Separation and identification of amino acids by 2D paper chromatography 9. SDS-polyacrylamide slab gel electrophoresis of proteins. | | |

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| | Course Code: MZOID101 | Course Title: Parasitology | |
| | Course Credit: 4 | Total contact hours: 60 Hrs | |
| | Course outcomes: <ul style="list-style-type: none"> • Have a basic understanding of the main concepts and definitions within the discipline. • Have an overview of the major taxonomic groups of parasites occurring in vertebrates and have insight into general biological adaptations that characterize each parasite group. • Gain insight into parasites' population ecology, including factors affecting infection pressure and spread rate of a parasite in a host population • Understand how important parasitic properties are influenced by evolutionary processes. • Become familiar with how parasites affect physiological, behavioural and ecological adaptations in the host. • Have an overview of key research questions in parasitology | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | UNIT I Introduction of parasitology: <ol style="list-style-type: none"> 1. Animal association 2. Types of Parasites 3. Types of Hosts 4. Inter relationship between host and parasite responses and hosts to parasitic infection. 5. Mode of transmission of parasite, Host specificity and parasitic adaptation. | | 15 Hrs |
| 2 | UNIT II Vectors : <ol style="list-style-type: none"> 1. Definition of vectors and types of vectors 2. Epidological consideration (Malaria). 3. Relationship of vertebrate pathogen to vector immunology. 4. Population studies and effectiveness of vector 5. Study of following Arthropod vectors (Medical and veterinary importance) with respect to their habit, habitat, life cycle, morphology and control measures: 1) Mosquito, 2) Human louse, 3) Triatomin bugs, 4) Black fly, 5) Housefly, 6) Tsetse fly, 7) Rat flea, 8) Ticks, 9) Mites. | | 15 Hrs |
| 3 | UNIT –III Study of parasites from protozoa & cestoda : <ol style="list-style-type: none"> 1. Life cycle of Trypanosoma and clinical manifestation in humans. | | 15 Hrs |

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| | <p>2. Life cycle of leishmania and clinical manifestation in humans.</p> <p>3. Study of intestinal flagellates - Giardia, Trichomonus, Gregarina.</p> <p>4. General life cycle of cestodes - Taenia, Echinococcus and clinical manifestation in humans.</p> <p>5. Study of Diphylidium and Amphilina.</p> | |
| 4 | <p>UNIT –IV :</p> <p>Study of parasites from Trematoda&Nematoda:</p> <p>1. Life cycle of Schistosomo, Faciola and clinical manifestation in humans.</p> <p>2. Study of Paragonimus, Opisthorchis.</p> <p>3. Life cycle of Wuchreia, Ancylostoma and clinical manifestation in humans.</p> <p>4. Study of Strongyloides, Entrobisus.</p> <p>5. Plant nematodes & Soil nematodes: Life cycle of Cyst nematode and citrus nematode.</p> | 15 Hrs |
| | <p>Suggested readings :</p> <ol style="list-style-type: none"> 1. Parasitism – by Read C.P. Prenters Hall of India Pvt. Ltd., New Delhi. 2. Foundation of Parasitology – By Schmidt, G.D. & Robert, L.S. (1981) 2nd Ed. C.V. Mosby Co. St. Lohis ISSR. 3. Helminths, Arthropods &Protozoo of domesticated Animals. By E.J.L. soulsby, ELBS publication London Ed. 1969 ed. 4. Human helminthology Manual for Clinical, Sanitarians Medical Zoologists – Faust, EmerestCaroll. 5. Introduction Animal Parasitology – By Smit. D.G. (1997) 2nd Ed. Johns Willey Sons New York. 6. Medical Parasitology by Markell, Voge and John, 8thed. W.B. Saunders Co. 7. Parasitism &Symbiology – By C.P. Read (1970) Ronald Press New York. 8. Parasitology – by Chandler and Chands, A Text book of Parasitology by S.S. Kelkar and Rohini S. Kelkar, Bombay popular prakashan. 9. Parasitology – By Hobler, E.R. and Noble, G.A. (1982) 2nd Ed. Lea & Febieger U.S.A. 10. Parasitology – By K.D. Chaterjee, Medical Pulisher Calcutta, 1987. 11. Parasitology (Protozoology and Helminthology) -SoodPammik (1993) CBS Publication and Distrubution, Delhi. 12. Physiology of parasites – By L.S. Chapell, John, Willey &Sions N.Y. (1980). 13. Synopsis of Digenetic Trematodes of Vertebrates - Yamaguti S. (1971) Vol. I & II Keigaku Publishing Co., Tokyo, Japan. 14. Systema Helminthum Vol. IV Monogenea and Aspidobothria - Yamaguti S. (1963) Inter- Science Publishers, London. 15. Text book Medical Parasitology Jaypee Brothers, - Medical Publishers, New York. - Panikar C.K.J (1988) 16. The Biology of animal parasites, Cheng T.C. (1964)-Saunders International Student Edition. 17. The Biology of parasitism and introduction to the study of associate organism- by White field, P.J. (1977) University Parks Press Baltimore. | |

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| | 18. The Invertebrates Vol II, McGraw Hill, New York.- Dawes B. (1946). 19. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977) | |
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| | Course Code: MZOLAB104 | Course Title: Parasitology | |
| | Course Credit: 2 | Total contact hours: 60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | |
| | <ol style="list-style-type: none"> 1. Collection, identification and permanent mounting of insect vector/s (submission of at least 2 slides). 2. Study of life cycle of mosquitoes. 3. Study of mouth parts of Mosquito and House fly. 4. Collection of Helminthes parasites from fish/fowl/goat, intestines. <ol style="list-style-type: none"> i. Collection of trematodes, nematodes and cestodes from various hosts. ii. Preservation, staining and identification of collected Trematode & cestodes, and preparation of their permanent slides (submission of at least, 05 from cestodes & 05 from trematodes). 5. Study of different trematodes, nematodes and cestodes from permanent slides. 6. Study of protozoa from different habitats: <ol style="list-style-type: none"> a. Marine Protozoa, b. Planktonic protozoa, c. Soil protozoa. 7. Examination of faecal samples for ova of helminth parasites 8. Histopathology - To study the effect of helminth parasites (histopathology) on their host's tissue by microtechnique (collection, preservation, processing, sectioning and staining). | | |

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| | Course Code: MZOGE101 | Course Title: Biodiversity and Conservation | |
| | Course Credit: 2 | Total contact hours:30 Hrs | |
| | <p>Course Outcomes:</p> <ul style="list-style-type: none"> • On satisfying the requirements of this course, students will have the knowledge and skills to:Articulate why society strives to conserve biodiversity. • Identify key threats to biodiversity. • Evaluate which management options are likely to be effective for conserving biodiversity in different settings. • Develop appropriate policy options for conserving biodiversity in different settings. • Communicate informed critique or analysis of biodiversity conservation policy and practice across a range of mediums. | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT I Basics in Biodiversity:</p> <ol style="list-style-type: none"> 1. Concept and definition of biodiversity 2. Evolution of biodiversity 3. Biodiversity at global, country and local levels 4. Factors promoting high diversity 5. Endemism and Hotspots 6. Measures of Bio-diversity 7. Significance of Biodiversity | | 15 Hrs |
| 2 | <p>UNIT II Biodiversity Conservation :</p> <ol style="list-style-type: none"> 1. Loss of biodiversity 2. Threats to biodiversity 3. Listing of threatened biodiversity 4. Goals of biodiversity conservation. 5. In-situ and Ex- situ conservation methods 6. Conservation through gene banking preservation. 7. Role of Native people. 8. Role of NGOs, Colleges and Universities | | 15 Hrs |

Suggested readings :

1. Primack, R.B. (1950): A primer of conservation biology 3rd edition
Sinuer Associates Inc. Publishers Sunderland Massachutts USA.
2. Ray Samitan Ray A.K. (2006): Biodiversity and Biotechnology New
Central Book Agency (P) Ltd.
3. Wilson, E.O.: Biodiversity
4. An advance Text book on Biodiversity: K. V. Krishnamurthy
5. Biodiversity and Biotechnology: Ray and Ray
6. Biodiversity – Mandal and Nandi
7. Perspective in environmental studies: Kaushik and Kaushik
- 8.** Biodiversity : K. C. Agarwal

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| | Course Code: MZOAE101 | Course Title: IPR and Patents | |
| | Course Credit: 2 | Total contact hours:30 Hrs | |
| | <p>Course Outcomes :</p> <ul style="list-style-type: none"> • The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works . • During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations . • Pave the way for the students to catch up Intellectual Property(IP) as an career option <ul style="list-style-type: none"> i. R&D IP Counsel ii. Government Jobs – Patent Examiner iii. Private Jobs iv. Patent agent and Trademark agent v. Entrepreneur | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT 1: Intellectual Property Right</p> <ol style="list-style-type: none"> 1. Basic concept of Intellectual Property 2. Characteristics and Nature of Intellectual Property rights 3. Justifications for protection of IP 4. Major International Instruments relating to the protection of IP <ul style="list-style-type: none"> i. Berne Convention ii. Paris Convention iii. TRIPS 5. Copyright 6. Trade Marks 7. Trade-secret 8. Traditional knowledge. | | 15 Hrs. |
| 2 | <p>UNIT 2: Patenting biotechnology inventions</p> <ol style="list-style-type: none"> 1. What constitutes the patent? 2. The patent process 3. The conditions to be satisfied for an invention to be patentable <ul style="list-style-type: none"> i. Novelty, ii. Inventiveness, iii. Usefulness 4. Types of inventions that are not patentable in India 5. Patenting and fundamental research. | | 15 Hrs. |

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| | <p>6. Patenting in different countries. 7. Patent and non-patent literature searching. 8. How to read a Patent.</p> | |
| | <p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Lionel Bently & Brad Sherman, Intellectual Property Law, Oxford. 2. P. Narayanan, Intellectual Property Law, Eastern Law House 3. Nithyananda, K V. (2019). <i>Intellectual Property Rights: Protection and Management</i>. India, IN: Cengage Learning India Private Limited. 4. Neeraj, P., & Khusdeep, D. (2014). <i>Intellectual Property Rights</i>. India, IN: PHI learning Private Limited. 5. R. S. Crespi, Patents – a basic guide to patenting biotechnology, Cambridge Univ. Press 6. S. S. Purohit, Biotechnology – Fundamentals and applications, 3rd Edition, Agrobios, India 7. Patent Facility Centre (PTC) Technology information, Forecasting and Assessment 8. Council (TIFAC), Department of Science and Technology, New Delhi 9. Ahuja, V K. (2017). <i>Law relating to Intellectual Property Rights</i>. India, IN: Lexis Nexis. <p>Reference Journal:</p> <ol style="list-style-type: none"> 1. Journal of Intellectual Property Rights (JIPR): NISCAIR <p>E-resources:</p> <ol style="list-style-type: none"> 1. Subramanian, N., & Sundararaman, M. (2018). <i>Intellectual Property Rights – An Overview</i>. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf 2. World Intellectual Property Organisation. (2004). <i>WIPO Intellectual property Handbook</i>. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf | |

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I/II/III/IV (Year) CC/ID/SEC/DSE Theory Examination
Subject Code:
Title of Paper:

Day/Date
Slot: 2.5 Hrs.

Time
Total Marks 60

Instructions: *i) Attempt all questions*
ii) Each Questions carry equal marks (12 marks)
iii) Draw neat and labeled diagrams wherever necessary.

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|---|----|----|
| Q. 1. (Based on Unit I) | | 12 |
| | Or | |
| Q. 1. A. (Based on Unit I) | | 06 |
| B. (Based on Unit I) | | 06 |
| Q. 2. (Based on Unit II) | | 12 |
| | Or | |
| Q. 2. A. (Based on Unit II) | | 06 |
| B. (Based on Unit II) | | 06 |
| Q. 3. (Based on Unit III) | | 12 |
| | Or | |
| Q. 3. A. (Based on Unit III) | | 06 |
| B. (Based on Unit III) | | 06 |
| Q. 4. (Based on Unit IV) | | 12 |
| | Or | |
| Q. 4. A. (Based on Unit IV) | | 06 |
| B. (Based on Unit IV) | | 06 |
| Q. 5. Attempt any 04 out of 08 (2 from each unit) questions based on entire syllabus. | | |
| A. | | 03 |
| B. | | 03 |
| C. | | 03 |
| D. | | 03 |
| E. | | 03 |
| F. | | 03 |
| G. | | 03 |
| H. | | 03 |

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I/II/III/IV (Year) GE/AEC Theory Examination
Subject Code:
Title of Paper:

Day/Date
Slot: 1.5 Hrs.

Time
Total Marks 30

Instructions: *i) Attempt all questions*
ii) Each Questions carry equal marks (12 marks)
iii) Draw neat and labeled diagrams wherever necessary.

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| Q. 1. (Based on Unit I) | | 12 |
| | Or | |
| Q. 1. A. (Based on Unit I) | | 06 |
| B. (Based on Unit I) | | 06 |
| Q. 2. (Based on Unit II) | | 12 |
| | Or | |
| Q. 2. A. (Based on Unit II) | | 06 |
| B. (Based on Unit II) | | 06 |
| Q. 3. Attempt any 02 out of 04 (2 from each unit) questions based on entire syllabus. | | |
| A. | | 03 |
| B. | | 03 |
| C. | | 03 |
| D. | | 03 |

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I (Year) Practical Examination
Subject Code: MZOLAB101

Title of Paper: Non-Chordata (Systematics and Functional Anatomy)

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| Day /Date | Time Slot: 3 Hrs. Total Marks 50 |
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| Q. 1. Identify and describe. | 10 |
| Q. 2. Identify/dissect/describe the system. | 10 |
| Q. 3. Describe the larvae or/any mounting | 10 |
| Q. 4. Submission of field report | 05 |
| Q. 5. Viva | 05 |
| Q. 6. Journal | 10 |

* Candidates are required to present certified journal and report (if any) on the day of practical examination.

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I (Year) Practical Examination
Subject Code: MZOLAB102
Title of Paper: Developmental Biology

| Day /Date | Time Slot: 3 Hrs. Total Marks 50 |
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Q. 1. Isolation of limb-bud and its chorioallantoic grafting in chick embryo. 10

Or

Q. 1. Identify the asexual reproduction in the given sample of paramecium and write a note on the process of culturing the paramecium. 10

Q. 2. Identify and describe given developmental stage of *C. elegans*. 10

Or

Q. 2. Identify and describe given life cycle stage of *Drosophila*. 10

Q. 3. Identify and describe the given specimen as per instructions (3 mark each) 15

a. Identify the stages of *Trilobium/Sitophilus* and its significance in indirect development.

b. Identify stage in hydra/sponge

c. Identify and describe T.S. of body wall of *Platyhelminths/Ascaris/earthworm*

d. Identify and describe the larva planula/mysis/tornaria

e. Identify and describe the stages of chick embryo 24hrs/33hrs/48hrs.

Q. 4. Viva 05

Q.5. Journal 10

* Candidates are required to present certified journal and report (if any) on the day of practical examination.

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I (Year) Practical Examination
Subject Code: MZOLAB103
Title of Paper: Research Methodology – I

Day /Date **Time Slot: 3 Hrs.**
Total Marks 50

Q.1. Using Henderson Hasselbalch equation calculate the pH of buffer prepared by mixing known volume of either acid and or salt solutions. Check pH using pH meter. 10

Or

Q. 1. Identify given amino acid sample by 2D paper chromatography. 10

Q.2. Identification of lipids in a given sample by TLC 07

Or

Q.2. Separate pigments from given leaves/flowers by adsorption column chromatography. 07

Q. 3. Separate given protein samples by SDS-polyacrylamide slab gel electrophoresis. 08

Or

Q. 3. Determine the pKa of the given weak acid. 08

Q. 4. Identification and describe Laboratory safety symbols (5 identification 2 marks each) 10

Q. 5. Viva voce 05

Q. 6. Journal. 10

* Candidates are required to present certified journal and report (if any) on the day of practical examination.

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I (Year) Practical Examination
Subject Code: MZOLAB104
Title of Paper: Parasitology

Day /Date **Time Slot: 3 Hrs.**
Total Marks 50

Q.1. Stain, mount and identify the insect vector from the given sample 10

Or

Q.1. Collect, stain, mount and identify the helminth parasite from the given intestines of goat/hen/fish. 10

Q.2. Collect the ova/cyst of helminth from the given faecal sample, mount and identify. 10

Or

Q.2 Carry out staining procedure for histopathology for the slides provided . 10

Q.3. Identify and describe (3 marks each) 15

a. Insect vector

b. Any one stage of life cycle of mosquito

c. Mouthparts of mosquito/honeybee

d. Trematode/nematode/cestode

e .Marine Protozoa/Plank tonic protozoa/Soil protozoa

Q.4. Viva 05

Q.5 Journal 10

* Candidates are required to present certified journal and report (if any) on the day of practical examination.

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| | Course Code: MZOCC201 | Course Title: Chordata (Systematics and Functional anatomy) | |
| | Course Credit:4 | Total contact hours:60 Hrs | |
| | <p>Course Outcome :</p> <ul style="list-style-type: none"> • Learners would be equipped with the understanding of morphology and phylogeny of Protochordates and Agnatha. • Learners would be equipped with the understanding of morphology and phylogeny of chordates. • Learners would understand Functional and Comparative Anatomy of Chordates. • Learners would obtain additional knowledge of diverse characteristics of various chordates | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT I :</p> <p>Protochordates and Agnatha:</p> <p>1. Protochordates :</p> <p>1) Origin and ancestry of Protochordates, similarities and differences with Invertebrates and Chordates.</p> <p>2) Comparison of characteristics between subphyla Urochordates and Cephalochordates.</p> <p>2. Urochordates :</p> <p>1) Life History of Herdmania and its phylogenetic affinities.</p> <p>3. Cephalochordates :</p> <p>1) General features and phylogenetic affinities.</p> <p>2) Life history of Branchiostoma.</p> <p>4. Ostracoderm :</p> <p>1) Salient features and biological significance.</p> <p>2) Interrelationship and affinities with Fish.</p> <p>5. Cyclostomes :</p> | | 15 Hrs |

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| | <p>1) Resemblance with Cephalochordates, Vertebrates and differences from Fishes.</p> <p>2) Life history of Petromyzon.</p> | |
| 2 | <p>UNIT II:</p> <p>Phylogeny of Chordates:</p> <p>1. Ancestry of Chordates.</p> <p>2. Pisces :</p> <p> 1) General characters of Dipnoi and affinities with Fishes, Elasmobranchs and Amphibia.</p> <p> 2) Origin of air bladder and its relationship with tetrapodlungs.</p> <p> 3) Deep sea adaptations of fishes.</p> <p> 4) Origin of fins.</p> <p>3. Amphibia :</p> <p> 1) Origin of Tetrapods</p> <p> 2) Pedomorphosis</p> <p> 3) Adaptive radiation in amphibians Lepospondyli and Lissamphibia</p> <p>4. Reptilia :</p> <p> 1) Origin of Reptiles and affinities with Amphibia</p> <p> 2) Terrestrial adaptations in Reptiles.</p> <p>5. Aves :</p> <p> 1) Origin of Birds and affinities with Reptiles.</p> <p> 2) Adaptive radiation in Birds –Ratitae (Flightless Birds) and Carinatae (Flying Birds).</p> <p> 3) Origin of Flight – Theory of Cursorial and Arboreal Origin.</p> <p>6. Mammalia :</p> <p> 1) Origin of Mammals.</p> <p> 2) Phylogeny of terrestrial and aquatic mammals.</p> | 15 Hrs |

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| 3 | <p>Unit III :</p> <p>Functional and Comparative Anatomy of Chordates :</p> <ol style="list-style-type: none"> 1. Comparative Anatomy of: <ol style="list-style-type: none"> 1) Chondrocranium. 2) Splanchnocranium. 3) Skull in different Vertebrates. 2. Evolution and Comparative Anatomy of Excretory System of Chordates : <ol style="list-style-type: none"> 1) Evolutionary development of Kidney. <ol style="list-style-type: none"> a) Archinephros. b) Pronephros. c) Mesonephros. d) Metanephros. 3. Comparative Anatomy of Nervous System in Vertebrates : <ol style="list-style-type: none"> 1) Brain. 2) Sense organs – Eyes and Ears. 4. Comparative Anatomy of Respiratory organs : <ol style="list-style-type: none"> 1) Gills, Skin and Lungs. 5. Comparative anatomy of Circulatory organs: Heart and Aortic Arches. 6. Male and female reproductive and urinary ducts of Vertebrates (Cyclostomes, Teleost, Elasmobranchs, Amphibia, Reptilia, Aves and Mammalia). | 15 Hrs |
| 4 | <p>Unit IV:</p> <p>Assorted Topics on Chordates :</p> <ol style="list-style-type: none"> 1. Retrogressive metamorphosis in Ascidians. 2. Pisces : <ol style="list-style-type: none"> 1) Evolutionary significance Crossopterygians, Placoderms Migration. | 15 Hrs |

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| | <p>2) Lateral line sense organ and electric organs.</p> <p>3. Amphibia :</p> <p>1) Evolutionary significance of Labyrinthodonts.</p> <p>4. Reptilia :</p> <p>1) Evolutionary significance of Dinosaurs.</p> <p>2) Venom apparatus and biting mechanism in snakes.</p> <p>5. Aves :</p> <p>1) Migration.</p> <p>2) Flight adaptations.</p> <p>6. Mammalia :</p> <p>1) Dentition in mammals.</p> <p>2) Habitat diversification.</p> <p>3) Walking gait: Plantigrade, Digitigrade and Unguligrade.</p> <p>4) Comparative account of Jaw suspension.</p> | |
| | <p>Suggested readings :</p> <p>1. Introduction to General Zoology, Volume II– K. K. Chaki, G. Kundu, S. Sarkar(NCBA).</p> <p>2. Vertebrate Zoology– F. B. Mondal (Oxford IBH)</p> <p>3. Modern Text Book of Vertebrates– R. L. Kotpal (Rastogi)</p> <p>4. Alexander, R. M. The Chordata. Cambridge University Press, London.</p> <p>5. Barrington, E. J. W. The biology of Hemichordata and protochordata. Oliver and Boyd, Edinburgh.</p> <p>6. Kingsley, J. S. Outlines of comparative anatomy of vertebrates. Central Book Depot, Allahabad.</p> <p>7. Kent, C. G. Comparative anatomy of vertebrates.</p> <p>8. Smith, H. S. Evolution of chordate structure. Hold Rinehart and Winston Inc., New York.</p> <p>9. Torrey, T. W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York.</p> <p>10. Romer, A. S. Vertebrate Body, III Ed. W. B. Saunders Co., Philadelphia</p> <p>11. Young, J. Z., Life of mammals, The Oxford University Press, London</p> | |

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| | <p>12. Colbert, E. H., Evolution of the vertebrates. John Wiley and Sons Inc., New York.</p> <p>13. Weichert, C. K. and Presch, W. Elements of Chordate anatomy. 4th Edn. McGraw Hill Book Co., New York.</p> <p>14. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.</p> <p>15. Andrews, S. M. Problems in vertebrate evolution. Academic Press, New York.</p> <p>16. Waterman, A. J. Chordata structure and function. Macmillan Co., New York.</p> <p>17. Lovtrup, S. The phylogeny of vertebrate. John Wiley & Sons, London</p> <p>Barbiur, T. Reptiles and Amphibians: Their habits and adaptations. Hongton Miffin Co., New York.</p> <p>18. Smyth. Amphibia and their ways. The Macmillan Co., New York.</p> <p>19. Jordan and Verma. Chordate Zoology, S. Chand Publication.</p> | |
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| Course Code: MZOLAB201 | Course Title: Chordata (Systematics and Functional anatomy) | |
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| Course Credit:2 | Total contact hours:60 Hrs | |
| Course Contents (Topics & subtopics) | | Reqd. hours |
| <p>1. Museum specimens/Photographs/Pictures/slides:</p> <p>a) Protochordates:StudyofDoliolum,Herdmania,Ascidia, Botryllus.</p> <p>b) Adaptive radiation in reptiles: Turtles,Crocodile,Tuatara, Snakesand Lizards.</p> <p>c) Adaptive radiation in Mammals : Talpa (mole),Tarsius, Armadillo, Camel and Spermwhale</p> <p>3. Comparative study of Pelvic and Pectoral girdle in vertebrates.</p> <p>4. Types of jaw suspension in vertebrates- Autodiastylic, Holostylic, Amphistylicand Autostylic.</p> <p>5. Types of vertebrae:Acoelous/Amphiplatins, Procoelus, Amphicoelus,Heterocoelus, Atlas and Axis.</p> <p>6. Pigeon: Study of/Virtual dissection :</p> <p>a) Digestive system</p> <p>b) Respiratory system</p> <p>c) Circulatory system</p> <p>d) Excretory system</p> <p>e) Reproductive-male and females.</p> <p>7. Local field visit to National park/Sanctuary/Museum/Zoo or any other suitable ecosystem to study vertebrates.</p> | | |

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| | Course Code: MZOCC202 | Course Title: Biochemistry | |
| | Course Credit:4 | Total contact hours: 60 Hrs | |
| | Course Outcome : <ul style="list-style-type: none"> • Learners will have in-depth understanding of the fundamentals of chemical basis of life. • Learners will have knowledge of the structures, interactions, and importance of complex bio molecules and their significance in living system. • Learners' will have in-depth understanding of the bioenergetics and metabolic pathways of various bio molecules. • Learners will gain knowledge of the regulatory mechanisms underlying various metabolic pathways. | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | UNIT 1: Fundamentals of Biochemistry : <ol style="list-style-type: none"> 1. Structure of atoms, molecules and chemical bonds, hydrogen bond, thermal properties of water and their biological significance. 2. Concept of <i>pH</i>, Dissociation of weak acids and weak bases, Henderson- Hasselbalch Equation, Titration curves of strong and weak acids, concept of buffer, buffers in biological systems 3. Glycoprotein: blood group Determinants, Complex Lipids: Phospholipids, Sphingolipids, Gangliosides, Sterols and Waxes, Lipoproteins: classification and functions of chylomicrons, VLDL, LDL, HDL and free fatty acid-albumin complex. 4. Biological Macromolecules: Composition, structure of monomers and polymers, functions of carbohydrates, lipids, proteins, nucleic acids and vitamins, Stability of | | 15 Hrs. |

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| | <p>Proteins and Nucleic Acids; Stabilizing Interactions such as <i>Vander Waals</i>, Electrostatic, Hydrogen Bonding, Hydrophobic Interactions , Central role of Carbon.</p> | |
| 2 | <p>Unit II: Metabolic Pathways :</p> <ol style="list-style-type: none"> 1. Carbohydrate and Lipid Metabolism: <ol style="list-style-type: none"> 1) Glycolysis and its energetic. 2) Gluconeogenesis: reaction sequence from pyruvate, Gluconeogenesis from amino acids, glycerol, propionate and lactate 3) Glycogen metabolism: Glycogenesis, Glycogenolysis. 2. Fatty acid metabolism: Oxidation of saturated even and odd carbon atom, and unsaturated fatty acids, metabolism of cholesterol. 3. Proteins as polymers of amino acids: Amino acids structure, classification based on structure, polarity, nutritional requirement and metabolic fate 4. Properties of amino acids; derivatives of amino acids, nontranscribed amino acids as protein constituents, D-amino acids. 5. Biological functions of proteins. Biologically important peptides: glutathione, octa-, nano-, and deca-peptides. | 15 Hrs. |
| 3 | <p>Unit III : Regulation of Metabolism :</p> <ol style="list-style-type: none"> 1. Regulatory enzymes :1) Covalently modulated, 2) Allosteric regulation, 3) Isoenzymes (LDH, CK, ALP, ADH), Nonprotein enzymes-Ribozymes., 2. Advanced enzymes in human healthcare (e.g. fungal lactase, | 15 Hrs. |

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| | <p>Hemicellulase, Trypsin chymotrypsin mix)</p> <p>3.Regulation of metabolic flux by genetic mechanisms: Control ofenzyme synthesis, constitutive and inducible enzymes; induction and repression of enzymes(lac operon and trp operon).</p> <p>4. Regulation of metabolism by extracellular signals: Nutrient supply, Nutrient transport, Endocrine control, Neural control.</p> | |
| 4 | <p>Unit IV:</p> <p>Inborn Errors of Metabolism:</p> <p>1. Carbohydrate metabolism: Glycogen storage disease, G-6-PD deficiency.</p> <p>2. Lipid metabolism: Metabolic disorders of cerebrosides.</p> <p>3.Protein metabolism: PKU, Albinism, Cysteinurea.</p> <p>4.Purine metabolism: Primary Gout.</p> <p>5.Mineral metabolism and diseases: Hypocalcaemia, Hypercalcaemia and osteoporosis.</p> | 15 Hrs. |
| | <p>Suggested Readings:</p> <p>1. Lehninger, L. Albert, David, L. Nelson, Michael, M. Cox(1993). Principles of Biochemistry, CBS Publishers and Distributors, Delhi.</p> <p>2. Stryer, L (1988), Biochemistry, W.H. Freeman and Company, New York.</p> <p>3. Cooper, T.G (1977). The Tools of Biochemistry, Wiley Interscience Publication, John Wiley and Sons, New York.</p> <p>4. Smith(1983). Principles of Biochemistry, 7th edn. McGraw Hill (Mammalian Biochemistry). New York.</p> | |

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| <p>5. Voet, D. & Voet, J (1995). Biochemistry, John Wiley and Sons, New York.</p> <p>6. Biochemistry 6th Ed, (2007) Berg Jeremy, Tymoczko John, Stryer Lubert, Publisher: W. H. Freeman, New York.</p> <p>7. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.</p> <p>8. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.</p> | |
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| | Course Code: MZOLAB202 | Course Title: Biochemistry | |
| | Course Credit: 2 | Total contact hours: 60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. Hours |
| | <ol style="list-style-type: none"> 1. To determine the titration curve of strong and weak acid. 2. Determination of glucose by Benedict's method (volumetric.) 3. Determination of glycogen in the given tissue (liver/ skeletal muscle / kidney/ brain). 4. Quantitative estimation of amino acids using ninhydrin reagent. 5. Determination of acid value of fats/ oils. 6. Determination of creatinine in serum and urea 7. Isolation of starch from potato. 8. Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample: Molisch's test; Anthrone test; Iodine test; Barfoed's test; Seliwanoff's test; Fehling's test; Benedict's test; Picric acid test and Bial's test. 9. Qualitative tests for amino acids and Proteins: Ninhydrin test; Xanthoproteic test; Millon's test and Biuret test. | | |

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| | Course Code: MZOCC203 | Course Title: Research Methodology II | |
| | Course Credit: 4 | Total contact hours:60 Hrs | |
| | <p style="text-align: center;">Course Outcome :</p> <ul style="list-style-type: none"> • On successful completion of the course students will be able to: • Search for, select and critically analyse research articles and papers. • Prepare a literature review. • Formulate and evaluate research questions. • Develop a research proposal or industry project plan. • Gain experience with instrument development and data collection methods. • Gain experience with ethics proposals | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT I :</p> <p>Recent techniques in biological sciences :</p> <ol style="list-style-type: none"> 1. Flow cytometry. 2. X-Ray crystallography. 3. ICP (Induction coupled plasma) and ICP-MS (Inductively coupled plasma – Mass spectrometry). 4. PCR (Polymerase chain reaction) and RT-PCR (Reverse Transcription -Polymerase Chain Reaction). 5. DNA Sequencer. | | 15 Hrs |
| 2 | <p>UNIT II :</p> <p>Principles and application of Spectroscopy:</p> <ol style="list-style-type: none"> 1. Spectroscopy: <ol style="list-style-type: none"> 1) Ultraviolet and visible absorption spectroscopy. 2) Fluorescence spectroscopy. | | 15 Hrs |

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| | <p>3) Nuclear magnetic resonance spectroscopy and ESR.</p> <p>4) Mass spectroscopy.</p> <p>5) Atomic absorption spectrophotometer.</p> | |
| 3 | <p>Unit III</p> <p>Statistical Methods:</p> <ol style="list-style-type: none"> 1. Introduction to Biostatistics; Biostatistics for Biologist. 2. Measures of central tendency and Dispersion. <ol style="list-style-type: none"> 1) Arithmetic Mean, Median, Mode and Range 2) Mean deviation, Standard Deviation, Standard error 3) Coefficient of Variation 3. Probability distributions (Binomial, Poisson and normal) 4. Sampling Theory. <ol style="list-style-type: none"> 1) Confidence Interval; Errors; Levels of significance 5. Statistical tests: Student t-test, χ^2 (Chi-square) test, Analysis of variance (ANOVA). 6. Regression and Correlation. 7. Hypothesis testing. | 15 Hrs |
| 4 | <p>Unit IV</p> <p>Methodology in scientific research:</p> <ol style="list-style-type: none"> 1. Introduction to Research Methodology <ol style="list-style-type: none"> 1.1. Objectives, Types, Significance 1.2. Research process, criteria of good research, Problems encountered by researchers 2. Research Problem and Research Design 3. Sampling Design and Methods of Data Collection. 4. Interpretation and Report Writing. <ol style="list-style-type: none"> 4.1. Interpretation and Presentation of data 4.2. Types of Report 4.3. Report Format 4.4. Typing instructions and oral Presentation. | 15 Hrs |

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| | <p>Suggested readings :</p> <ol style="list-style-type: none"> 1. Modern Experimental Biochemistry; 3rd Ed. Rodney Boyer, Pearson Education. 2. Principles and Techniques of Practical Biochemistry. Wilson and Walker, Cambridge Univ. Press. 3. Biological Science; 3rd Ed. D. J. Taylor, N.P.O. Green, G. W. Stou, Cambridge Univ. Press 4. Cell and Molecular Biology- Concepts and Experiments, Gerald Karp. John Wiley & Co. 5. Introductory Practical Biochemistry; S. K. Swahney, Randhir Sing. Narosa Publ. 6. An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGraw Hill 7. Elementary Practical Organic Chemistry Part I: Small Scale Preparations 2nd Ed. Arthur I. Vogel. CBS Publ. and Distributors. 8. Statistical Methods in Biology; N.T.J. Baily, Cambridge Univ. Press. 9. Biostatistics, Basic Concepts and Methodology for Health Sciences, 10th Eds.; W.W. Daniel and C.L. Cross, John Wiley & Co. 10. Introduction to Biostatistics and Research Methods, 5th Eds.; P.S.S. SundarRao and J. Richard. PHI Learning Pvt. Ltd. Delhi. 11. Methods in Biostatics for medical students and research worker, 6th eds. B.K. Mahajan, jaypee Bros. Medical Publisher Ltd. 12. A Textbook of Biostatistics; B. Annadurai, New Age International Publisher. 13. Practical Research Planning and Design; 2nd Ed. Paul D. Leedy. Macmillan Publ. 14. Research Methodology. Methods and Techniques, 2nd Eds.; C.R. Kothari. Wiley Eastern Ltd. Mumbai. 15. Research Methodology. Methods and Techniques, 3rd Eds.; C.R. Kothari and G. Garg. New Age International Publisher. | |
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| | Course Code: MZOLAB203 | Course Title: Research Methodology II | |
| | Course Credit:2 | Total contact hours:60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| | <ol style="list-style-type: none"> 1. Demonstration of Polymer Chain Reaction (PCR). 2. Colorimeter: Selection of filter and determination of unknown concentration of solution. 3. Colorimetric estimation of protein by Peterson and Lowry method. 4. Student t-test. 5. Analysis of variance (Two way ANOVA). 6. χ^2 (Chi-square) test. 7. Graphical representation of scientific data. 8. Abstract writing from data/model research article provided. 9. Writing scientific Research Proposal/ Review article. (Submission). | | |

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| | Course Code: MZOID201 | Course Title: Histology and Histochemistry | |
| | Course Credit: 4 | Total contact hours:60 Hrs | |
| | <p>Course Outcome:</p> <ul style="list-style-type: none"> • Learners will study the techniques of microtomy and its significance. • They will get the knowledge of histological structures of tissues / organs. • Similarly they will learn the Histochemical techniques, their principle and applications. With help of all these studies students will get the ability to apply their knowledge in field of parasitology, immunology and pathology. • They will be able to apply this knowledge for their further research oriented studies. • They will have opportunity of self-employment, entrepreneurship etc. | | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| 1 | <p>UNIT I: Microtomy and Techniques in Histology :</p> <ol style="list-style-type: none"> 1. Sample preparation. 2. Obtaining tissue samples. 3. Handling reagents. 4. Fixation methods, types of fixatives and their effect on tissue. 5. Processing of fixed samples. 6. Dehydration (procedure and significance). 7. Embedding of tissue, block making, trimming of blocks. 8. Microtomes: <ol style="list-style-type: none"> 1) Rocking Microtome 2) Rotatory Microtome 3) Cryostat (Freezing Microtome) 4) Ultra-microtome | | 15 Hrs |

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| | 9. Section cutting process and Spreading of ribbon, causes of defects in ribbon and remedies for it. | |
| 2 | <p>Unit II :</p> <p>Fundamentals of histology :</p> <p>1) Tissues :</p> <ol style="list-style-type: none"> 1) Epithelial tissue. 2) Connective tissue. 3) Muscular tissue. 4) Nervous and other specialized tissues. <p>2) Histological study of following mammalian organs (Rat):</p> <ol style="list-style-type: none"> 1) Tubular digestive organs: Structural plan, oesophagus, stomach, small intestine, large intestine. 2) Liver and pancreas. 3) Respiratory organs: Trachea, bronchi and lungs. 4) Excretory organs: Kidney, renal ducts, and urinary bladder. 5) Male reproductive organ: Testis. 6) Female reproductive organ: Ovary. | 15 Hrs |
| 3 | <p>Unit III :</p> <p>Types of biological stains and dyes :</p> <ol style="list-style-type: none"> 1) Biological stains, source and their staining actions. 2) Natural and synthetic dyes, dye binding reactive groups. 3) Mordant. 4) Progressive and regressive staining methods. 5) Nature of staining action. 6) Staining Procedures, Mounting media, mounting techniques. 7) Basic and acidic stains, Counter stains, Haematoxyline staining, Mallory staining. | 15 Hrs |

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| 4 | <p>Unit IV :</p> <p>Fundamentals of histochemical techniques :</p> <ol style="list-style-type: none"> 1) Principle, scope and significance of histochemistry. 2) Histochemical classification of carbohydrates and principle identification of carbohydrates (periodic acid/ Schiff's method (PAS)). 3) Histochemical localisation of mucopolysacchrides by KMNO₄/AB and PAS method. 4) Histochemical classification of lipids, principle for the demonstration of lipids in various animal tissues (copper thyocyanin method and Sudan black B method). 5) Histochemical classification and localization of proteins. 6) Histochemical localization of acid and alkaline phosphatase. 7) Histochemical localization of calcium. | 15 Hrs |
| | <p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Berne R. N. and Levy M. N., (1966). Principles of Physiology (Mosby year book). 2. Bloom and Fawcett D. (1972). Text Book of Histochemistry 10th ed. 3. David H. c. (1987) Histology 9th ed. (HorperInternational Pub.). 4. Gomori, G. (1952). Microscopic Histochemistry: principles and Practices, The University of Chicago Press, Chicago and London. 5. Pearse A. G. E. (1968). Histochemistry Vol. 1 & 2. 6. McManus J.F.A. and Mowry R. W. (1960) Staining Methods. 7. K. Shamsundari and K. HanumanthaRao (2007). Histochemistry in focus : A Source Book of Techniques and Research needs (Publisher M. J. Publishers, Chennai, India.) 8. Tembhare D. B.: Techniques in Life Sciences. 9. L. R. Patki: An Inroduction to Microtechnique (S. chandCompanyLtd. Ram Nagar New Delhi -110055). | |

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| | <p>10. Stoword, P. J. and Pearse A. G. E. (1991): Histochemistry (Vol. I- III) 4th Ed. (Publisher: Churchil Livingstone Edinburgh, London.).</p> <p>11. J. E. Kiernan (2008). Histological and Histochemical Methods : Theory and Practice 4th Ed. (Publisher : Schion Publishing Ltd. Oxford Shire).</p> <p>12. L. P. Gartner and J. L. Hiat (2000): Colour atlas of Histology 3rd Ed. publisher: Lippincott Williams and Wilkins's Baltimore.</p> <p>13. William F. Windle: Text Book of Histology.A.L. Kierszenbaur (2002).Histology and Cell Biology : An Introduction to Pathology (Publisher : Mosby Inc. St. Louis U.S.A.).</p> <p>14. W. M. Copenhaver (1964).Baile''s Text Book of Histology (Publisher: The Williams and Wilkin'sCompany,Baltimore).</p> | |
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| | Course Code: MZOLAB204 | Course Title: Histology and Histochemistry | |
| | Course Credit:2 | Total contact hours:60 Hrs | |
| Sr. No. | Course Contents (Topics & subtopics) | | Reqd. hours |
| | <ol style="list-style-type: none"> 1. Fixation, dehydration, embedding, block preparation and trimming of block. 2. Microtome and its working. Sectioning, staining and permanent mounting of tissues. 3. Study of permanent slides of histology of intestine, liver, kidney, ovary and testis (mammals). 4. Microscopic measurements of histological samples using micrometers and planimeters. 5. Whole mount staining technique. 6. Feulgen reaction to demonstrate nucleic acids in biological tissues. 7. PAS reaction to demonstrate carbohydrates in biological tissues. 8. AB reaction to demonstrate carbohydrates in biological tissues 9. Sudan Black B staining for lipids in biological tissues. 10. Localisation of calcium in the tissue Alizarine-red method. <p>Note: Submission of 3 + 2 slides (Histology and Histochemistry respectively)</p> | | |

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| | Course Code: MZOSE201 | Course Title: Sericulture | |
| | Course Credit: 4 | Total contact hours: 60 Hrs | |
| | Course Outcome: <ul style="list-style-type: none"> • Students will get the knowledge about silk producing insects and silk industry. • They will get the skill of rearing of silkworms, development of mulberry garden and cocoon production. • Students will get the knowledge of silk pests and diseases and their control measures. • Subject has self-employment value and student can start this activity at his / her own business. | | |
| Sr. no. | Course Contents (Topics & subtopics) | | Reqd. hours |
| | Unit I : Silkworm : Classification and types and morphology: <ol style="list-style-type: none"> 1. History of Sericulture. 2. Scope of sericulture in India and in world. 3. Central Silk Board. 4. Classification of silkworm: A brief account of class, order and detailed account of the family. Saturniidae and Bombycidae. 5. Types of silkworms: <ol style="list-style-type: none"> a) Mulberry, Eri, Muga and Tasar silkworm. b) Morphological details of mulberry silkworm (Egg, larva, pupa and adult). | | 15 Hrs |
| | Unit II : Biology, Anatomy and Physiology of Silkworm: | | 15 Hrs |

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| | <ol style="list-style-type: none"> 1. Life cycle of mulberry silkworm. 2. Silkworm (<i>Bombyxmori</i> L.) growth and development: Embryonic and post embryonic development. 3. Silk gland and silk synthesis. 4. Anatomy and physiology of : <ol style="list-style-type: none"> 1) Digestive system. 2) Excretory system. 3) Respiratory system. 4) Circulatory system and haemolymph. 5) Nervous system. 6) Reproductive system. | |
| | <p>Unit III :</p> <p>Silkworm Rearing Technology :</p> <ol style="list-style-type: none"> 1. Period of rearing, deciding date of brushing, quantity of brushing, conditions of mulberry growth and yield of mulberry. 2. Availability of labour. 3. Rearing space/house. 4. Rearing equipment. 5. Disinfection of rearing house and rearing equipment. 6. Hatching, brushing, methods of brushing. 7. Feeding of silkworms. 8. Bed cleaning. 9. Spacing. 10. Care during moulting. 11. Environmental conditions:Temperature, humidity, light and air. 12. Leaf quality, harvesting and storage of leaves. 13. Rearing methods for early age and late age silkworms. 14. Mounting and types of mountages. 15. Harvesting and marketing of cocoons. 16. Normal and abnormal cocoons. | 15 Hrs |

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| | <p>Unit IV :</p> <p>Silkworm grainage, diseases, pests of silkworm and their control measures :</p> <ol style="list-style-type: none"> 1. Selection, preservation and transport of seed cocoons. 2. Emergence of moths and egg laying. 3. Selection of DFL and disinfection of eggs. 4. Refrigeration of eggs. 5. Termination of diapause. 6. Viral, fungal, bacterial and protozoan diseases of silkworm and their control measures. 7. Silkworm pests : Uji fly, Dermistid beetle, ants, squirrels and birds. | 15 Hrs |
| | <p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Silkworm Rearing by K. Veda, M. Horikomi and I. Nagai; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 2. A textbook of Applied Entomology (Methods of Insect Pest Control) Vol. 1 by K. P. Shrivastava; Kalyani Publishers, Ludhuyana, New Delhi, Noida. 3. The Silkworm: Biology, Genetics and Breeding, by Dilip De Sarker. 4. An Introduction to Sericulture by G. Ganga and J. S. Chetty. 5. Manual on Sericulture (Vol. I to IV) edited by Krishnaswamy <i>et al.</i>, (1970); Food and Agricultural Industries Service, Agricultural services Division, FAO, UN, Rome, Italy. | |

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I/II/III/IV (Year) CC/ID/SEC/DSE Theory Examination
Subject Code:
Title of Paper:

Day/Date
Slot: 2.5 Hrs.

Time
Total Marks 60

Instructions: *i) Attempt all questions*
ii) Each Questions carry equal marks (12 marks)
iii) Draw neat and labeled diagrams wherever necessary.

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| Q. 1. (Based on Unit I) | | 12 |
| | Or | |
| Q. 1. A. (Based on Unit I) | | 06 |
| B. (Based on Unit I) | | 06 |
| Q. 2. (Based on Unit II) | | 12 |
| | Or | |
| Q. 2. A. (Based on Unit II) | | 06 |
| B. (Based on Unit II) | | 06 |
| Q. 3. (Based on Unit III) | | 12 |
| | Or | |
| Q. 3. A. (Based on Unit III) | | 06 |
| B. (Based on Unit III) | | 06 |
| Q. 4. (Based on Unit IV) | | 12 |
| | Or | |
| Q. 4. A. (Based on Unit IV) | | 06 |
| B. (Based on Unit IV) | | 06 |
| Q. 5. Attempt any 04 out of 08 (2 from each unit) questions based on entire syllabus. | | |
| A. | | 03 |
| B. | | 03 |
| C. | | 03 |
| D. | | 03 |
| E. | | 03 |
| F. | | 03 |
| G. | | 03 |
| H. | | 03 |

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester I/II/III/IV (Year) GE/AEC Theory Examination
Subject Code:
Title of Paper:

Day/Date
Slot: 1.5 Hrs.

Time
Total Marks 30

Instructions: *i) Attempt all questions*
ii) Each Questions carry equal marks (12 marks)
iii) Draw neat and labeled diagrams wherever necessary.

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| Q. 1. (Based on Unit I) | | 12 |
| | Or | |
| Q. 1. A. (Based on Unit I) | | 06 |
| B. (Based on Unit I) | | 06 |
| Q. 2. (Based on Unit II) | | 12 |
| | Or | |
| Q. 2. A. (Based on Unit II) | | 06 |
| B. (Based on Unit II) | | 06 |
| Q. 3. Attempt any 02 out of 04 (2 from each unit) questions based on entire syllabus. | | |
| A. | | 03 |
| B. | | 03 |
| C. | | 03 |
| D. | | 03 |

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester II (Year) Practical Examination
Subject Code: MZOLAB201

Title of Paper: Chordata (Systematics and Functional Anatomy)

Day /Date **Time Slot: 3 hrs.**
Total Marks 50

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| Q. 1. Identify and describe the specimen. | 10 |
| Q. 2. Identify and describe any girdle or/vertebra/jaw suspension | 10 |
| Q. 3. Describe digestive/circulatory/respiratory/excretory/reproductive system of Pigeon. | 10 |
| Q. 4. Submission of field report. | 05 |
| Q. 5. Viva. | 05 |
| Q. 6. Journal | 10 |

* Candidates are required to present certified journal and report (if any) on the day of practical examination.

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester II (Year) Practical Examination
Subject Code: MZOLAB202
Title of Paper: Biochemistry

Day /Date

Time Slot: 3 hrs.

Total Marks 50

Q.1. Estimate the yield of glycogen from skeletal muscles / liver. Show the results to the Examiners and submit a report. 15

Or

Q. 1. Estimate the amount of Glucose by Benedict's volumetric method. Show the results to the examiners and submit a report. 15

Or

Q. 1. From the given material isolate Starch and estimate the yield. Show the results to the Examiners and submit a report. 15

Q.2. Determine the Acid Value of the given sample of lipid. Show the results to the examiners and submit a report. 15

Or

Q.2. Determine creatinine in serum / urea Show the results to the examiners and submit a report. 15

Or

Q.2. Determine the titration curve of strong /weak acid. Show the results to the examiners and submit a report. 15

Q.3. Identify the nature of carbohydrates in the given sample using qualitative tests (2tests). 05

Or

Q.3. Identify the nature of amino acids and Proteins in the given sample (2 tests) 05

Or

Q.3. Estimate amino acids from given sample using ninhydrin reagent 05

4. Viva 05

5. Journal 10

*Candidates are required to present certified journal on the day of practical examination.

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester II (Year) Practical Examination
Subject Code: MZOLAB203
Title of Paper: Research Methodology – II

Day /Date **Time Slot: 3 Hrs.**
Total Marks 50

Q.1. Selection of filter and determination of unknown concentration of solution A/B. 10

Or

Q. 1. A. Draw Pie diagram and Bar diagram from data provided. 05

B. Apply χ^2 (Chi-square) test for data provided. 05

Q.2. Determination of Protein in given sample 08

Q. 3. A. Write an abstract for given research article. 06

B. Apply Student t-test for data provided. 06

Q. 4. Submission of Research Proposal / Review article 05

Q. 5. Viva voce 05

Q. 6. Journal. 10

* Candidates are required to present certified journal and report (if any) on the day of practical examination.

Dr. Homi Bhabha State University
The Institute of Science
Madam Cama Road, Mumbai, 400032
M.Sc. Zoology Semester II (Year) Practical Examination
Subject Code: MZOLAB204
Title of Paper: Histology and Histochemistry

**Day
/Date**

**Time Slot: 3 Hrs.
Total Marks 50**

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| Q. 1. Proceed the given tissue for dehydration and prepare the paraffin blocs of it. | 10 |
| Q. 2. Take sections of tissue from given bloc and mount the ribbon on slide. | 10 |
| Q. 3. Show the histochemical localization of carbohydrates in given slide by AB/PAS technique. | 10 |
| Q.4. Viva vove. | 05 |
| Q. 5. Journal. | 10 |

* Candidates are required to present certified journal and report/Submission (if any) on the day of practical examination.