

ARYAVART INTERNATIONAL UNIVERSITY

Tilthai, Dharmanagar, North Tripura-799250

Syllabus for M Sc (Zoology)

Semester 1

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24ZO101	Taxonomy, Biosystematics and Biostatistics	4	0	0	4	70	30	0	100
24ZO102	Bio Instrumentation and Cell Biology	4	0	0	4	70	30	0	100
24ZO103	Animal Physiology and Endocrinology	4	0	0	4	70	30	0	100
Skill Enhancement Course (SEC)									
24CS101	Fundamentals of IT	3	1	0	4	70	30	0	100
Practical									
24ZO191	Taxonomy, Biosystematics and Animal Physiology	0	0	4	4	0	30	70	100
24ZO192	Bio Instrumentation and Cell Biology	0	0	4	4	0	30	70	100
<b>Total</b>					<b>24</b>	<b>280</b>	<b>180</b>	<b>140</b>	<b>600</b>

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**Detailed Syllabus**

**TAXONOMY, BIOSYSTEMATICS AND BIOSTATISTICS**

**Code: 24ZO101**

**Max. Marks: 70**

**Unit I: Biosystematics and Taxonomy**

1. Basic concept of Biosystematics, taxonomy and classification; classical and recent taxonomic parameters.
2. Newer trends in biosystematics- chemo, cyto and molecular taxonomy (DNA bar-coding in explaining).
3. Taxonomic key, its types and their role in classification.
4. Taxonomic characters and significance, ICZN.
5. Introduction of Species concept, biological and evolutionary species concept, difficulties in application of biological species concept, Supra and infra-specific and sibling species categories.

**Unit II: Biological classification**

1. Theories of biological classification.
2. Phylogenetic types of classification, systematic of animals and hierarchic classification, Zoological nomenclature-basic knowledge of naming on genus and species; Modern scheme of classification into sub-kingdom, division, section, phyla and minor phyla.
3. Phenetic method of classification, numerical phonetics and numerical taxonomy, preparation of data matrix and similarity matrix using distance method (Manhattan distance and Euclidian distance).
4. Cladistic method of classification, difference in application of phonetic and cladistic classification, Cladogram, Eludistic methods.

**Unit III: Functional biology of non-chordates**

1. Osmoregulation in protozoa.
2. Colonial protozoans and theories of origin of metazoans.
3. Feeding pattern and digestion in lower metazoans.
4. Life history, pathogenecity and control of *Fasciola hepatica*.
5. Exocrine gland (Lac, Wax, Silk and Labial gland).
6. Larval forms of echinoderms, metamorphosis and phylogenetic significance.
7. Structure and function of digestive organs in insect- pleotropic membrane and filter chamber.
8. Hydrostatic movement in Echinodermata and Annelids.
9. Mechanism of respiration by gills, book lung and trachea.
10. Respiratory pigments in non-chordates.
11. Mechanism of Excretion and excretory organs in Annelids and Arthropods.

**Unit IV: Minor phyla**

Salient features and affinities of-

1. Placozoa,
2. Mesozoa,
3. Ctenophora,
4. Rotifera,
5. Phoronida,
6. Sipuncula and
7. Bryozoa (Ectoporecta).

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**Suggested Readings:**

1. Barnes: Invertebrate Zoology (Holt-Saunders International, 4<sup>th</sup> edition, 1980).
2. Barnes: The Invertebrates –A synthesis, 3<sup>rd</sup> edition, Blackwell, 2001.
3. Hunter: Life of Invertebrates, Collier Macmillan Pub.1979.
4. Marshall: Parker & Haswell Text Book of Zoology, Vol. I, 7<sup>th</sup> edition, Macmillan, 1972.
5. Moore: An Introduction to the Invertebrates, Cambridge University Press, 2001.
6. Jordan & Verma: Chordate Zoology (1998, S. Chand).
7. Sinha, Adhikari & Ganguly: Biology of Animals (Vol. II, 1998, New Central Book Agency).
8. Chapman: The Insects: structure and function, 1998.
9. Srivastava: A textbook of applied entomology Vol. I & II Kalyani Publishers, New Delhi, 1988 ,1993.
10. Kapoor V. C.: Principles of Taxonomy.
11. Parker and Haswell: A Textbook of Zoology Vol. I (Revised).
12. E. Mayrand P. D. Ashlock: Principles of systematic Zoology (2ndEdition).



**BIO INSTRUMENTATION AND CELL BIOLOGY**

**Code: 24ZO102**

**Max. Marks: 70**

**UNIT I**

1. Microscopy: Phase contrast microscope, Fluorescence microscope, Electron microscope (TEM and SEM), Confocal microscope
2. General Principle and applications of Colorimeter and Spectrophotometer. Ultra centrifuge. Beer and Lambert's law.
3. Chromatography-Principles and applications of GLC & HPLC; Electrophoresis- PAGE and Agarose Gel Electrophoresis; Flow cytometry, NMR
4. Cryopreservation of cells, tissues, organs and organisms. Cryosurgery, Freeze fracture and freeze drying; Autoradiography; Immunological techniques- Immuno-diffusion, Immuno-electrophoresis, immune-fluorescence, ELISA.

**UNIT II**

1. Principles of tissue fixation & Staining, Histochemistry.
2. Microbiological techniques- Types of media and sterilization, Inoculation and growth monitoring, microbial assays, microbial identification; Cell culture Techniques- Design and functioning of a tissue culture laboratory, Culture and media preparation, Cell toxicity and cell viability testing.
3. In-situ hybridization-FISH; Blotting Techniques- Western, Northern and Southern Blotting.
4. Polymerase Chain Reaction (PCR).

**UNIT III**

1. Complexity and organisation of cell- Structural and Molecular feature of Prokaryotic and Eukaryotic cells.
2. Bio-membranes- Molecular composition and functional feature of membrane lipid, protein and carbohydrate.
3. Cytoskeletons- Structure and Organisation of Microfilament, Microtubule and Intermediate filament.
4. Cell Motility- Muscle contractility, intercellular transport, kinesin-dynin, cilia and flagella.

**UNIT IV**

1. Cellular Reproduction- Various Stages and molecular events in mitosis and Meiosis.
2. Extracellular Matrix and Cell Interaction- Cell walls, Adhesion junctions, tight junctions, Gap junctions, Plasmodesmata.
3. Cell-Cell Adhesion-  $Ca^{++}$  dependent and  $Ca^{++}$  independent Homophilic Cell-Cell Adhesion.
4. Cell-Cell Signalling- Cell Signalling, Cell surface receptors, G-Protein coupled receptors and Second messenger.

**Recommended Books:**

1. Alberts et al: Molecular Biology of the Cell (Garland, 2002).
2. Berg et al.: Biochemistry (5th Ed.), Freeman, 2002.
3. Biochemistry (3rd Ed.), Tata-McGraw Hill, 1990.
4. Boyer: Modern Experimental Biochemistry and Molecular biology (2nd Ed.), Benjamin/Cumin, 1993.
5. Brooker: Genetics: Analysis and Principles (Addison-Wesley, 1999).
6. DeRobertis & DeRobertis: Cell and Molecular Biology (Lee & Febiger, 1987).
7. Griffith et al: Modern Genetic Analysis (Freeman, 2002).
8. Hartl & Jones: Essential Genetics: A Genomic Perspective (Jones & Bartlet, 2002).
9. Karp: Cell and Molecular Biology (John Wiley & Sons, 2002).
10. Lewin, Genes VIII (Wiley, 2004).

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11. Lodish et al: Molecular Cell Biology (5th Ed.), Freeman, 2004.
12. Pollard & Earnshaw: Cell Biology (Saunders, 2002).
13. Russell: Genetics (Benjamin Cummings, 2002).
14. Snustad & Simmons: Principles of Genetics (John Wiley, 2003).
15. Switzer and Garrity: Experimental Biochemistry 92nd Ed.), Freeman, 1999.
16. T. A. Brown, Genome 3rd, Ed 17. Wilson and Walker: Practical Biochemistry (3rd Ed.), Cambridge Univ. Press, 2000.



**ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY**

**Code: 24ZO103**

**Max. Marks:**

**UNIT I**

1. Physiology of digestion: Glands and secretion of digestive enzymes, Mechanism of digestion, gastrointestinal hormones, Absorption of Carbohydrates, lipids and proteins.
2. Physiology of Respiration: Alveolar ventilation, alveolar-capillary gas exchange, Transport of O<sub>2</sub> and CO<sub>2</sub> in blood, Oxygen dissociation curve and the factors influencing it, Regulation of respiration.
3. Circulatory system in mammals, blood chemistry, blood groups, blood clotting mechanism, cardiac cycle and its regulation in mammals.
4. Musculature in vertebrates: Types of muscles, Ultrastructure and chemical composition of skeletal muscles, molecular mechanism and regulation of muscle contraction, muscle fatigue and rigor mortis.

**UNIT II**

1. Physiology of Excretion: Ultrastructure of nephron, mechanism of urine formation, excretion of dilute solutes and mechanism of excretion of excess solutes. Osmoregulation in different animal groups (aquatic and terrestrial).
2. Thermoregulation: Heat balance in animals, Adaptations to temperature extremes, Aestivation and hibernation, acclimatization, avoidance and tolerance, stress and hormone.
3. Neuron: Ultrastructure, types and function, Resting membrane, membrane potential, action potential, Nerst Equation, Chronaxi, Rheobase, utilization time.
4. Neural impulse induction through an axon, neurotransmitters and synaptic transmission mode of information transfer across electrical and chemical synapses.

**UNIT III**

1. Basic concept of Endocrinology, Hormone and homeostasis.
2. Chemical nature of hormones: Amino-acid derived hormones, Peptide hormones, Glycoprotein hormones, Steroid hormones and Prostaglandin.
3. Hormone receptor and target organ concept, Feedback system and trophic hormones.
4. Biosynthesis and mechanism of action of peptide and steroid hormones.

**UNIT IV**

1. Structure of pituitary gland; pituitary hormones and their functions Hypothalamo–hypophysial axis.
2. Structure of thyroid glands, thyroid hormones – biosynthesis and metabolic functions. Role of thyroid hormone in amphibian metamorphosis.
3. Structure of adrenal gland; Synthesis of adreno-cortical and medullary hormones and their functions.
4. Structure of endocrine pancreas and Hormones of Islets of Langerhans, testis & ovary – endocrine structure and their functions; Hormone therapy.

**Recommended Books:**

1. Brooks and Marshall: Essentials of Endocrinology, Blackwell Science. 1995
2. Ganong: Review of Medical Physiology (21st Ed.), Lang Medical Publications, 2003.
3. Guyton and Hall: Text Book of Medical Physiology (10th Ed.), W.B. Saunders, 2001.
4. Hadley: Endocrinology, Prentice hall. International Edition. 2000.
5. Keel et al: Samson Wright's Applied Physiology (13th Ed.), Oxford Press, 1989.
6. Keel et al: Samson Wright's Applied Physiology (13th Ed.), Oxford Press, 1989.
7. Larson: Williams Text Book of Endocrinology, 10th edition. W. B. Saunders Company, Philadelphia. 2002.
8. Murray et al: Harper's Illustrated Biochemistry (26th Ed.), Appleton & Lange, 2003.

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9. Murray et al: Harper's Illustrated Biochemistry (26th Ed.), Appleton & Lange, 2003.
10. Norris: Vertebrate Endocrinology (2nd ed). Lea & Febriger. 1997.
11. Turner and Bagnara: General Endocrinology, W. B. Saunders Company Philadelphia. 1984.
12. West: Best and Taylor's Physiological Basis of Medical Practice (11th Ed.), Williams and Wilkins, 1981.
13. West: Best and Taylor's Physiological Basis of Medical Practice (11th Ed.), Williams and Wilkins, 1981.





**FUNDAMENTALS OF IT**

**Code: 24CS101**

Max Marks: 70

**UNIT I**

**Fundamentals of Computers:** Definition and Characteristics of Computer System. Computer Generation from First Generation to Fifth Generation. Classifications of Computers: Micro, Mini, Mainframe and super computers.

**Computer Hardware:** Major Components of a digital computer, Block Diagram of a computer, Input-output devices, Description of Computer Input Units, Output Units, CPU.

**Computer Memory:** Memory Hierarchy, Primary Memory – RAM and its types, ROM and its types, Secondary Memory, Cache memory. Secondary Storage Devices - Hard Disk, Compact Disk, DVD, Flash memory.

**UNIT II**

**Interaction with Computers:** Computer Software: System software: Assemblers, Compilers, Interpreters, linkers, loaders.

**Application Software:** Introduction to MS Office (MS-Word, MS Power point, MS-Excel).

**Operating Systems:** Elementary Operating System concepts, Different types of Operating Systems.

**DOS:** Booting sequence; Concepts of File and Directory, Types of DOS commands.

**Computer Languages:** Introduction to Low-Level Languages and High-Level Languages.

**UNIT III**

**Computer Number System:** Positional and non-positional number systems, Binary, Decimal, Octal and Hexadecimal Number Systems and their inter-conversion.

**Binary Arithmetic:** Addition, subtraction, multiplication and division. Use of complement method to represent negative binary numbers, 1's complement, 2's complement, subtraction using 1's complement and 2's complement. Introduction to Binary Coded Decimal (BCD), ASCII Codes, EBCDIC codes.

**UNIT IV**

**Computer Network & Internet:** Basic elements of a communication system, Data transmission modes, Data Transmission speed, Data transmission media, Digital and Analog Transmission, Network topologies, Network Types (LAN, WAN and MAN), Basics of Internet and Intranet.

**Internet:** Terminologies related to Internet: Protocol, Domain name, Internet Connections, IP address, URL, World Wide Web. Introduction to Client-Server Model, Search Engine, Voice over Internet Protocol (VOIP), Repeater, Bridge, Hub, Switch, Router, Gateway, Firewall, Bluetooth technology.

**Advanced Trends in IT Applications:** Brief Introduction to Cloud Computing, Internet of Things, Data Analytics, AI and Machine Learning.

**Text Book:**

1. P. K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications, 1992.
2. Anita Goel "Computer Fundamentals", Pearson.

**Reference Books:**

1. B. Ram Computer Fundamentals Architecture and Organization, New Age Intl.
2. Alex Leon & Mathews Leon, "Introduction to Computers", Vikas Publishing.
3. Norton Peter, "Introduction to computers", 4th Ed., TMH, 2001.
4. Vikas Gupta, "Comdex Computer Kit", Wiley Dreamtech, Delhi, 2004.

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**TAXONOMY, BIOSYSTEMATICS AND ANIMAL PHYSIOLOGY (PRACTICAL)**

Code: 24ZO191

Max. Marks: 70

**Contents:**

1. Collection, preservation, curation and identification of non-chordate and chordate species (only pest and cultured species).
2. Taxidermy of fish/rat/pigeon/fowl.
3. Identification with only diagnostic features (specimen or model/diagnostic photograph):
  - a. *Spongilla*, one coelenterate, *Ascaris* (male & Female), *Fasciola*, *Taenia*, Earthworm, Leech, *Julus*, King crab, spider, crab, prawn (fresh water), cricket, leaf insect, stick insect, beetle (one), butterfly (one), grasshopper, termite, *Pila*, sepia, *Achitina*, Slug, Echinodermata (any one)
  - b. *Puntius*, *Labeo*, *Cyprinus*, *Ctenopharyngodon*, *Hypophthalmichthys*, *Cirrihinus*, *Clarius*, *Anabas*, *Mystus*, *Mastocemba*, *Macrognathus*, *Hoplobatrachus*, *Polypedates*, *Rhacophorus*, *Euphlectys*, *Fejervarya*, *Moina*, sparrow, Parrot, rabbit, Duckbill platypus, Bat, monkey, whale/dolphin.
4. Survey and application of biodiversity indices of animal species (any one group).
5. Calculation of Pearson correlation coefficient., T test (One sample t-test, Two sample t test, Paired t-test); Chi square test, ANOVA, Mann-Whitney test from supplied data.
6. Detection of blood groups and Rh factor. Comparison of RBC and WBC in different groups of Vertebrate.
7. Dissection and mounting of pituitary gland from fish.
8. Determination of rate of Respiration.
9. Micronuclei assay from blood cells to study geno-toxicity.
10. Preparation of practical record and submission.
11. Viva-voce.



**BIO INSTRUMENTATION AND CELL BIOLOGY (PRACTICAL)**

**Code: 24ZO192**

**Max. Marks: 70**

**Contents:**

1. Study of structural arrangement of plasma membrane using model/chart.
2. Identification of various stages of mitosis and meiosis from prepared slides.
3. Temporary squash preparation of onion root tip cells to study stages of mitosis and Grasshopper/*Gryllotalpa testis* to study meiotic stage of cell division.
4. Preparation of temporary sex chromatin from buccal epithelial cell
5. Squash preparation and identification of salivary gland chromosomes in *Drosophila* / *Chironomus* larvae.
6. Preparation of agarose gel for gel electrophoresis; Demonstration of gel loading, gel runs for electrophoresis.
7. Estimation of total protein and glycogen using spectrophotometer/ colorimeter.
8. Separation and identification of amino acid by paper chromatography and TLC.
9. Preparation of fixatives and stains.
10. Preparation of culture media and sterilization.
11. Preparation of practical record and submission of materials related to above.
12. Viva-voce.

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**Theory Paper**

Total: 100 Marks  
External: 70 Marks  
Internal: 30 Marks

**External: 70 Marks**

10 Question (MCQ): 1 marks each (1x10 = 10)  
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)  
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)  
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

**Internal: 30 Marks**

Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Practical: 100 Marks  
External: 70 Marks  
Internal: 30 Marks

**External (Two programs): 70 Marks**

**Program Writing:** 10 + 10 Marks  
**Algorithm & Flowchart:** 5 + 5 Marks  
**Program Execution:** 15 + 15 Marks  
**Viva:** 10 Marks

**Internal Assessment (30 Marks)**

Internal Assessment Examinations will be conducted, carrying 50 marks  
**Record:** 5 Marks  
**Attendance:** 5 Marks  
**Program Writing:** 15 Marks  
**Program Execution:** 15 Marks  
**Viva:** 10 Marks

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