Swami Ramanand Teerth Marathwada University, 'Dnyanteerth', Vishnupuri, Nanded, PIN – 431 603 Maharashtra State, INDIA

SCHOOL OF LIFE SCIENCES
SYLLABUS- M. Sc. ZOOLOGY- THEORY AND PRACTICAL

Year 2017 Onwards

ABOUT THE DEPARTMENT AT A GLANCE:

The Post-Graduate Department in Zoology was established in the campus in 2009-10. The Department offers 3 programs in zoology, viz, M.Sc., M.Phil. and Ph.D. The Department makes use of instrumentation laboratory and computer laboratory in School of Life Sciences for organizing the classroom teaching in addition to E-learning tools and resources for the teaching programs.

The Department within a short period of time has taken initiatives to impart good education not only in terms of providing knowledge about the subject but to enable them to develop communication skills and instil confidence among them but also encourage the students to take up and participate in various activities organized by the department and university.

The Two Year (**Four Semester**) CBCS teaching program in Zoology has an intake of 20 students. The course structure is of interdisciplinary nature and the contents of the theory are designed in units for each paper as per UGC guidelines. Similarly, we follow the digital alternatives and ICT based learning devices for laboratory courses as per the directives of UGC. The course curriculum also includes dissertation for the partial fulfilment of the degree in Zoology from third semester onwards.

In addition, the M. Phil. and Ph. D. programs are also offered where course work is mandatory for every student The students are encouraged to participate in seminars and conferences organised by the department from time to time.

The department is also actively involved in organizing other Academic Activities, study tours for the benefit of students and researchers:

1. National Level Symposium on Aquaculture Biotechnology

2. State Level Seminar cum Workshop on Computer assisted Learning resources in Animal Experiments
3. Tools and Techniques for Biodiversity Assessment- Seminar cum workshop
4. Awareness on IPR
5. National Workshop on Preparation of Organic Manure from fish Market Wastes for horticulture.
6. State level one day program on Apiculture, Vermicomposting and Sericulture Practices to promote scientific temperament are significant.
7. Workshop on awareness and conservation of snakes.

Swami Ramanand Teerth Marathwada University, 'Dnyanteerth', Vishnupuri, Nanded, PIN – 431 603 Maharashtra State, INDIA.

SCHOOL OF LIFE SCIENCES

Department of Zoology

M. Sc. Zoology Syllabus- 2017 onwards

(CBCS Pattern)

OUTLINE OF THE COURSE STRUCTURE

Semester	Code No.	Name of the Paper	No. of Periods /Semester	Type of Paper	Total Credits	Internal Exam Marks	External Exam Marks	Total Marks
First Semester		**THEORY**						
	ZOT-101	Biochemistry	60	Common Paper	04	50	50	100
	ZOT-102	Bioinstrumentation	60	Common Paper	04	50	50	100
	ZOT-103	Cell Biology	60	Common Paper	04	50	50	100
	*ZOT-104	Animal Taxonomy and Evolution	60	Subject paper	04	50	50	100
	ZOS-105	Seminar			01			25
		Total Credits = 17						
Semester	**Code No.**	**Name of the Paper**	**No. of Periods /Semester**		**Total Credits**	**Internal Exam Marks**	**External Exam Marks**	**Total Marks**
Second Semester		**THEORY**						
	ZOT-201	Genetics and Molecular Biology	60	Common Paper	04	50	50	100
	ZOT-202	General Microbiology	60	Common Paper	04	50	50	100
	ZOT-203	Invertebrate & Vertebrate Structure and Function	60	Subject paper	04	50	50	100
	*ZOT-204	Ecology and Animal Behaviour	60	Subject paper	04	50	50	100
	ZOS-205	Seminar			01			25
		Total Credits = 17						
Semester	**Code No.**	**Name of the Paper**	**No. of Periods /Semester**		**Total Credits**	**Internal Exam Marks**	**External Exam Marks**	**Total Marks**
Third Semester		**THEORY**						
	ZOT-301	R-DNA Technology	60	Common Paper	04	50	50	100
	ZOT-302	Biostatistics and Bioinformatics	60	Common Paper	04	50	50	100
	*ZOT-303	Applied Zoology	60	Subject paper	04	50	50	100
	ZOT-304	Environmental Pollution and	60	Subject paper	04	50	50	100

		Toxicology						
	ZOS-305	Seminar			01			25
		Total Credits = 17						
Semester	**Code No.**	**Name of the Paper**	**No. of Periods /Semester**		**Total Credits**	**Internal Exam Marks**	**External Exam Marks**	**Total Marks**
Fourth Semester		**THEORY**						
	ZOT-401	Animal Physiology and Endocrinology	60	Subject paper	04	50	50	100
	ZOT-402	Fish Biology and Aquaculture	60	Subject paper	04	50	50	100
	ZOT-403	Animal Biotechnology	60	Subject paper	04	50	50	100
	*ZOT-404	Parasitology	60	Subject paper	04	50	50	100
	ZOS-405	Seminar		Subject paper	01		25	25
		Total Credits = 17						

Credits of Theory of four semesters = 68

Laboratory Course: First Year (1st & 2nd Semester)

Code	Title	Credits	Internal Exam Marks	External Exam Marks	Total Marks
ZOL-1	Lab Course – I (Biochemistry and Bioinstrumentation)	4	50	50	100
ZOL-2	Lab Course – II (Cell Biology, Genetics and Molecular Biology)	4	50	50	100
ZOL-3	Lab Course-III (Animal Taxonomy and Evolution, Invertebrate and Vertebrate Structure and function)	4	50	50	100
ZOL-4	Lab Course–IV (Ecology Animal Behaviour and General Microbiology)	4	50	50	100
		Total Credits= 16			

Laboratory Course: Second Year (3rd & 4th Semester)

Code	Title	Credits	Internal Exam Marks	External Exam Marks	Total Marks
ZOL-5	Lab Course–V (R-DNA Technology, Biostatistics and Bioinformatics)	4	50	50	100
ZOL-6	Lab Course –VI (Fish Biology and Aquaculture, Parasitology)	4	50	50	100
ZOL-7	Lab Course –VII (Animal Biotechnology, Environmental Pollution and Toxicology, Animal Physiology)	4	50	50	100
ZOD-8	Dissertation/Review Writing	4	50	50	100

	Total Credits = 16

(Common Paper indicates that the paper is common for M. Sc. Zoology, M. Sc. Botany, M. Sc. Biotechnology and M. Sc. Microbiology courses.)

Credits of Laboratory Courses of four semesters = 32

- Note: * indicates Elective Paper. The student may select elective paper from other courses of the school
- Total credits of all semesters = 100
- Total Marks of all semesters = 2500
- S indicates Seminar, T indicates Theory. and L indicates Laboratory.
- Weightage for Field Visit and report submission in the second year
- Two Internal Exams each of 20 Marks (based on MCQs) and an assignment of 10 Marks for each paper is compulsory.
- The examinations for laboratory Courses (External) will be held at the end of 2nd & 4th Semesters.

Special papers are designed as Non-Major Elective Course: 4 Credits of theory offered to Zoology & other disciplines in 4th Semester

1. Bioethics and Biosafety
2. Alternatives to animal Experiments

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – I (Year 2017 onwaqrds)
(Choice Based Credit System)
Syllabus- Theory Paper - I
Paper Code: ZOT- 101
Title of the Paper – Biochemistry
Total Credits – 04, Number of Periods – 60

Course Objective: Objective of this course is to help the student to navigate the discipline of Biochemistry that explains how the collection of innaminate molecule

BIOCHEMISTRY (30 Lectures)

Unit-1: The Matrix and Energetics of Life

1. The origin of Life. Origin of basic biological molecules. Abiotic synthesis of organic monomers and polymers.
2. Stabilizing interactions (Vander waals, electrostatic hydrogen bonding, hydrophobic interaction etc.
3. Role of water in biological processes, structure and properties of water.
4. Acids and bases. Henderson Hesselbatch equation, Buffer solutions, Physiological and Biological Buffers, problems.
5. The energetic of Life: Endergy, heat and work. Internal energy and state of system.
6. First law of thermodynamics. Enthalpy, Entropy. Second law of thermodynamics. Free energy, interplay of enthalpy and entropy.
7. Concept of work, chemical equilibrium and potential, chemical equilibrium and free energy change. Equilibrium constant. High energy phosphate compounds. Free energy changes and equilibrium constant. Biological System problem.

Unit-2

1. Introduction to Amino acids and proteins.
2. Amino acid, structure, stereochemistry and properties of Amino Acids.

3. Non-standard, Modified Amino acids.
4. Peptides and peptide bond.
5. Biologically important peptides.
6. Structure of proteins, Ramchandran plot.
7. Fibrous proteins, Globular proteins, collagen, elastin, keratins, myoglobins, haemoglobins, haemoglobin varients and pathological effects, Ptotein sequencing.

Unit-3

1. Molecular Archetecture of living matter.
2. The nature of Nucleic acids. Neucleotides, nitrogenous basess. Purines and pyramidine bases. Sugars, sugar packers and nucleotides.
3. Polynucleotides and primary structure of Nucleic acids. Secondary and tertiary structure of Nucleic acids.
4. Chargaft's rule.
5. Double stranded DNA. Alternative nucleic acid structures (A, B, Z DNA) triple and quadraplex structures.
6. Thermal ™ supercoil form of DNA, Linking number, Twist number and Writhe number. EtBr effects on supercooling.
7. RNA Types and biological functions. Plasticity and secondary and tertiary DNA structures.

UNIT-IV

1. Classification and derivation of mono-sacharides, oligosaccharides and structure. Stability and formation of glycoside bonds, polysaccharides.. Glycoproteins, oligosaccharides as cell markers. Sequencing of oligosaccharides, Chemical properties. Structure and properties, classification of lipid aggregates.
2. Biological membranes. Membrane assembly and protein targetting. Lipoproteins, excitable membranes. Action potential and neurotransmission.

Suggested readings:

Biochemical calculations- Erwin, H. Segel. John Willy and Sons.
General Chemistry- Linus Pauling. W. H. Freeman and Company
Organic Chemistry- D. J. Cram and G. S. Hanmond. Mc Grew Hill.

Biochemistry-D. Voet and J. G. Wileymand Sons.

Physical Biochemistry- D. Frefilelder. W. H. Freemand and Company.

Laboratory Techniques in Biochemistry and Molecular Biology, Worh and Work.

Understanding Chemistry, CNR Rao, Universities Press, Hyderabad.

A biologists Guide to Principles and Practices in Biochemistry- K. Wilson and K. H. Coulding. ELBS, 1986.

Tools of Biochemistry- T. G. Cooper.

Biochemistry- G. H. Well.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – I (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper – II
Paper Code: BOT/MBT/BTT/ZOT- 102
Title of the Paper – Bioinstrumentation
Total Credits – 04, Number of Periods – 60

Scope

Unit I

Chromatography and Centrifugation

General principles, classification, separation, mechanisms, their layer, affinity, gel permeation, ion exchange, GLC, HPLC, ,HPTLC, Preparative and analytical centrifugations and their applications.

Unit II

Electrophoresis

Basic principles of electrophoresis, factors affecting electrophoresis, Electrophoretic mobility, paper and gel electrophoresis, Native and denaturing PAGE, iso-elective forming, purse field gel electrophoresis.

Unit III

Spectroscopy

Theory and applications of ultra violet and visible spectroscopy, in forced (IR), Nuclear magnetic resonance(NMR), AAS, Mass(MS) Ramon, Fluorescence and X-ray spectroscopy and applications.

Unit IV

Radiation and Non-Radioactive Techniques

Basic concepts of radiation, characteristics and properties of radiations and radioisotopes, dose response relationship, radioisotopes in diagnostics and biotechnology. Techniques for measurement of radioactivity: Geiger Muller Counter, Scintillation counter, metabolic tracer techniques, non-radioactive lableless, labelling and detection methods using fluorescent molecules, Biological applications of radioactive isotopes and safety aspects.

References:

1. Instrumental methods of Analysis 6th edition - H. H. Willard, L. L. Merrit Jr. and others, 1986 CBS Publishers and Distributors

2. Instrumental Methods of Chemical Analysis. 1989- Chatwal G. and Anand, S., Himalaya Publishing House, Mumbai.
3. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. 1975 – Williams B, L Wilson, K.
4. Spectroscopy Volume I – B. B. Straughan and Walker, Chapman and Hall Ltd.
5. Gcl Electrophoresis of Proteins- A Practical Approach – Hanes
6. Chromatography: Concepts and Contrasts, 1988- Jaines Miller, John Wiley and Sons Inc New York.
7. Analytical Biochemistry – Holme
8. Introduction to High Performance Liquid Chromatography – R. J. Hamilton and p. A. Sewall.
9. Spectroscopy- B. P. Straughan and S. Walker
10. Practical Aspects of Gas Chromatography and Mass Spectrometry 1984 - Gordon M. Message, John, Wiley and Sons New York.
11. Gel Chromatography – Tibor Kremmery, wiley Publications
12. Isotopes and Radiations in Biology – C. C. Thornburn. Butterworth and Co. Ltd. London
13. The Use of Radioactive isotopes in the Life Sciences – J. M. Chapman and Ayrey. George Allen and Unwin Ltd. London.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – I (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper - III
Paper Code: ZOT- 103
Title of the Paper – Cell Biology
Total Credits – 04, Number of Periods – 60

Scope

1. To study the structure and function of the basic unit of living organisms.
2. To study stages in cell cycle (including cell death and cancer), cell differentiation, and organelles and other cellular structures in the growth and functioning of the cell (including membrane transport and signaling).
3. To understand the basic concepts and processes in development of an organism.

Unit-1

1. Introduction to basic concepts of cell Biology, Overview of Prokaryotic and Eukaryotic cells.
2. Nucleus, Mitochondria and its genetic organization, Structure and organization of Chromatin.
3. Cytoskeleton: Microtubules- structure, composition, MAP, MIOC'S, functions. Intermediate Filaments – Types and functions.
4. Transport across cell membrane: Types of transport- Na & K ATPases, proton pumps, Bulk transport.

Unit-2

1. Cell interactions: cell adhesion, role of cell adhesion in inflammation and metastasis
2. Cell Cycle: Major events during G1, S, & G2 phases, regulation of cell cycle, cell cycle and apoptosis Cell signaling: Introduction to cell signaling, types of receptors, extra-cellular messengers and signal transduction with examples.

Unit-3

1. Introduction to concepts, terms & scope of Developmental Biology, Gametes and Fertilization: Morphology of generalized ovum, ultra-structure and function of mammalian sperm, Semen formation and composition, Pre-fertilization events, Post-fertilization events & Biochemistry of fertilization,
2. Embryo development: Neural Tube formation, Determination & induction.
3. Cell Differentiation & differential gene activity, Biology of Cancer: Types and characteristics, Oncogenes & tumour suppressor genes, and chemical carcinogenesis, biomarkers of cancer detection.

Unit-4

1. Metamorphosis in amphibians and insects, Regeneration in lower and higher animals.
2. Developmental genetics of *C. elegans* and *Drosophila melanogaster*.

Recommended Books:

The required text for this course is Alberts *et al.* "Molecular Biology of the Cell" 5th edition. Other texts that you may find useful are Lodish *et al*. "Molecular Cell Biology", Gilbert: "Developmental Biology".

SUGGESTED READINGS:

CELL BIOLOGY:

1. Cell and Molecular Biology – De Robertis.
2. Gene – IX, Benjamin Lewin, Oxford University Press..
3. Cell and Molecular Biology. – Gerald Karp, 5th Edition, John Willy and Sons. Inc. 2008.
4. Cell Biology – David E. Sadava, Jones and Bartlett Publishers, London, 1993.
6. Molecular Biology of Gene (V- Edition) – J. D. Watson, Lania A. Raker, Stephan P. Bell, Alexander Gann, Micheal Eveni – Pearson Education and Publication.

DEVELOPMENTAL BIOLOGY:

1. Introduction to Embryology, Balinsky B. I., Saunders, Philadelphia.
2. Developmental Biology, Berrill N. J and Carp G. Tata Mc Graw Hill & Co., New Delhi.
3. Gene Activity during early Development, Devidson E. ., Academic Press, New York.
4. Developmental Biology, Sinaver associated IAC, Massachusetts.
5. Animal Development- A laboratory Guide, Muthukuruppam, MKV, Madurai.
6. Foundation of Embryology, Patten.
7. Principles of Animal Developmental Biology, S. C. Goel, Himalya Publishing House.
8. Developmental Biology, Vasudev Rao, Oxford and IBH Pub. Co., New Delhi.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – I (2017) (Choice Based Credit System)
Syllabus- Theory Paper
Paper Code: **ZOT- 104**
Title of the Paper – Animal Taxonomy and Evolution
Total Credits – 04, Number of Periods – 60

Scope:

The paper is designed to make students aware not only of the great diversity which is being displayed by animals around us but also to prepare them theoretically and practically to study and arrange the Bio-diversity in scientific and natural manner. The theoretical background of systematics and taxonomy thus will go a long way in elucidating the natural grouping which exists in the biodiversity around us.

UNIT – I

1. Definition and basic concept of Biosystematics, taxonomy and classification, History of taxonomy, systematics, Taxonomic characters and their kinds and wetage.
2. Trends in animal taxonomy: Chemo-taxonomy, Cyto-taxonomy, Molecular taxonomy, Immuno-taxonomy & Para-taxonomy
3. 3.1. Theories of animal classification, Hierarchy of categories in animal classification, 3.2. Importance and application of Taxonomy (biosystematics) in biological studies, 3.3. Systematics as a profession and its future perspectives,

UNIT – II

2.1.1 Species categories and species concept.
a) Typological species concept.
b) Nominalistic species concept
c) Biological species concept
d) Evolutionary species concept.

2.1.2 Difficulties in application of Biological species concept.
2.1.3 Intra-specific categories & Taxons: a) variety, b) Subspecies c) super species d) Sibling species
2.1.4 The new systematics
2.1.5 Origin of new species taxa and their delimitation
2.1.6 Inventory and categories of higher taxa (Macrotaxonomy)

UNIT – III

1. Taxonomic Characters, Types of taxonomic characters, origin of reproductive isolation, biological mechanism of genetic incompatibility.
2. Taxonomic procedures, Taxonomic collections. Preservations and process of identification.
3. Taxonomic keys: Different categories of taxonomy and their merits, demerits, Taxonomic publications.
4. International Code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of different rules, formation of scientific Name of various taxa.
5. Tools and Techniques in Animal Taxonomy
6. Different types of camera for the field and laboratory studies.
7. Sound Recording and Echo-sound recording devices used in animal detection, Recording and Taxonomic studies.
8. The standard literature used as reference for the species Identification from Protozoa to Mammals.

UNIT – IV

1.0 Neo-Darwinism and Population Genetics: Hardy-Weinberg law of genetic equilibrium,

1.1. Forces for destabilization in the process of organic evolution : Natural selection, mutation, genetic drift, migration and meiotic drive.

2.0 Origin and evolution of Fishes. Dinosaurs and their extinction.

3.0 Molecular Population Genetics: Gene mutation- Patterns of changes in nucleotide and amino acid sequences.

3.1 Ecological significance of molecular variations (Genetic Polymorphism), Micro-evolution and Macro-evolution.

3.2 Phylogeny: Cladistics, dendrogram, construction of Phylogenetic tree and analysis.

SUGGESTED READINGS:

1. Molecular Markers,	Avise, J. C. .
2. Principles of Animal Taxonomy	Simpson G.G.
3. Elements of Taxonomy	Mayer E.
4. Biodiversity	Wilson E. O.
5. Evolution	Dobzhanskey, F. J. Ayala, J. M.Vatetine.
6. Genetics and Origin of species	Dobzhanskey, Columbia University Press.
7. The Diversity of Life	Wilson E. O.
8. Evolution	Sawage
9. Organic Evolution	Lull.
10. Evolution of Vertebrates	Colbert
11. Evolution and Genetics	Merrel D. J., Jones

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – II (Year 2017 onwards)
(Choice Based Credit System)
Syllabus- Theory Paper
Paper Code: ZOT- 201
Title of the Paper –Genetics & Molecular Biology
Total Credits – 04, Number of Periods – 60

Scope

The objective of this course is to provide a clear understanding of DNA so that they can manipulate and understand the basic tools and techniques involved in it. Strong foundation in genetics and molecular biology enables the students to familiarize themselves with genetic engineering.

Unit I
Genes, Mutation, Mutagenesis & Microbial genetic systems:

Overview of Mendelian Genetics, Fine structure of gene, types of mutations, UV and chemical mutagens; Ames test for mutagenesis; Methods of genetic analysis, Transformation, Conjugation, Transduction, Viruses and their Genetic systems: Phage I and its life cycle, RNA phages; RNA viruses; Retroviruses.

Unit II
DNA Replication, Recombinations & Repair
Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication, , Types & mechanism of DNA Repair, Process & types of Recombinations, Holiday junction, gene targeting, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.

Unit III
RNA Modifications and Transcription
Modifications in RNA: 5'-Capping, 3'-polyadenylation, and splicing, RNA editing, RNA stability, Process of Prokaryotic and Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing.

Unit IV
Translation and Protein Localization
Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post-translational modifications of proteins. Synthesis of secretary and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis.

References:

1. Molecular Cloning: a Laboratory Manual. J. Sambrook. E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. Introduction to Practical Molecular Biology, P.D. Dabre, John wiley & Sons Ltd., New York, 1988.
3. Molecular Biology LabFax, T.A. Bown (Ed.) Bios Scientific Publishers Ltd., Oxford, 1991.
4. Molecular Biology of the Gene (4^{th} Edition), J. D. Watson, N.H. Hopkins, J. W. Roberts, J. A. Steeitz and M. A. Weiner, The Benjamin/Cummings Publ. Co., Inc., California, 1987.
5. Molecular Cell Biology (2^{nd} Edition) J. Darnell, H. Lodish and d. Baltimore, Scientific American Books, Inc., USA, 1994.
6. Molecular Biology of the Cell (2^{nd} Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. d. Watson Garland publishing, Inc., New York, 1994.
7. Gene VI (6^{th} Edition) Benjamin Lewin, Oxford University Press, U.K., 1998.
8. Molecular Biology and Biotechnology. A comparative desk reference, R. A. Meyers (Ed.) VCH Publishers, Inc., New York, 1995.
9. Genomes, T. A. Brown.
10. 8^{th} Day of Creations

S.R.T.M. University, Nanded,

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M. Sc. Zoology, Semester – II (Year 2017 Onwards)

(Choice Based Credit System)

Syllabus- Theory Paper

Paper Code: ZOT- 202

Title of the Paper – General Microbiology

Total Credits – 04, Number of Periods – 60

UNIT-I MICROBIAL CHARACTERISTICS:

1. Introduction to microbiology and microbes, history and scope of microbiology,
2. morphology, structure, growth and nutrition of bacteria,
3. bacterial culture methods;
4. bacterial genetics: mutation and recombination in bacteria, plasmids, transformation, transduction and conjugation;
5. antimicrobial resistance.

UNIT-II MICROBIAL DIVERSITY:

1. Microbial taxonomy and evolution of diversity, classification of microorganisms, criteria for classification; classification of bacteria;
2. Cyan bacteria, acetic acid bacteria, Mycobacteria and Mycoplasma.
3. Acchaea; Halophiles, Methanogens, Hyperthermophilic archae, Thermoplasm; eukarya;
4. Algae, fungi, slime molds and protozoa; extremophiles and unculturable microbes.

UNIT-III VIROLOGY:

1. Virus and bacteriophages, general properties of viruses, viral structure, taxonomy of virus, viral replication, cultivation and identification of viruses;
2. sub-viral particles- viroids and prions.

UNIT-IV CONTROL OF MICROORGANISMS:

1. Sterilization disinfection and antisepsis: Physical and chemical methods for control of microorganisms,
2. Antibiotics, antiviral and antifungal drugs,
3. Biological control of microorganisms.

Host-microbes interaction:

1. Host-pathogen interaction, ecological impact of microbes;
2. Symbiosis (Nitrogen fixation and ruminant symbiosis); microbes and nutrient cycles;

3. Microbial communication system;
4. Bacterial quorum sensing; microbial fuel cells; prebiotics and probiotics.

S.R.T.M. University, Nanded,

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M. Sc. Zoology, Semester – II (Year 2017Onwards)

(Choice Based Credit System)

Syllabus- Theory Paper

Paper Code: ZOT- 203

Title of the Paper –Invertebrate & Vertebrate Structure and Functions

Total Credits – 04, Number of Periods – 60

Scope

1. To describe and explain the basic principles of animal classification, form and function among non-chordate phyla .
2. To describe the main elements of the biology and evolutionary relationships of the major groups of non-chordates
3. To describe the structure and function of vital organs among non-chordate phyla.

UNIT – I

1. Organization of Coelom : Acoelomata, Coelomata, Pseudocoelomata. Protostomia and Deuterostomia
2. Polymorphism, feeding and reproduction in Protozoa.
3. Feeding in Polychetes and Mollusca.
4. Respiratory Pigments in Invertebrates and vertebrates

UNIT- I I

1. Structure and working of organs of respiration – Skin/Integument, Trachea, Gills and lungs.
2. Excretion – Structure and working of Coelom, Coelomoducts, Nephridia and Malphigian tubules.
3. Primitive nervous system : Coelenterata and Echinodermata.
4. Advanced nervous system in Annelida, Arthropoda and Mollusca (Cephalopoda).
5. Larval forms in Invertebrates (Porifera to Echinodermata) and their Evolutionary Significance.

UNIT – III

1. Affinities of Protochordates to Vertebrates and Origin of Vertebrates.
2. Adaptive Radiation in Vertebrates.
3. Development, General structure and functions of Integument and its derivatives in vertebrates.
4. Evolution of Heart and Aortic arches in Vertebrates.

UNIT – IV

1. External and Internal respiration.
2. Comparative structure and working of respiratory organs in Fish, Amphibians and Mammals.
3. Comparative structure of alimentary canal and associated digestive glands in vertebrates.
4. Structure of brain and spinal cord in Fishes and mammals. Cranial nerves and their functions in fishes and Mammals.
5. Structure and working of Mammalian Ear and Eye.
6. Introduction to pouched mammals- Kangaroo, Aquatic mammals- Whales, Dugong, Seal and Walrus, Flying mammals- Bats.

SUGGESTED READINGS

1. Vertebrate Zoology – Prasad

3. Chordate Zoology- Jordan and Verma

4. Vertebrate Body – Romer, W. B. Saunders and Co. Philadelphia.

5. Life of Mammals – Young J. Z., Oxford University Press, London.

6. Evolution of Chordate Structure – Smith H. S.

7. Chordate Zoology – Dhami and Dhami.

8. Invertebrate Zoology-Kotpal and Kshetrapal- Rastogi Publication, Meerut.

9. Vertebrate Zoology- Kotpal and Kshetrapal- Rastogi Publication, Meerut.

S.R.T.M. University, Nanded,

Department of Life Sciences

M. Sc. Zoology, Semester – II (Year 2017 Onwards)

(Choice Based Credit System)

Syllabus- Theory Paper

Paper Code: ZOT- 204

Title of the Paper – Ecology and Animal Behaviour

Total Credits – 04, Number of Periods – 60

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1. To study higher levels of the organization of life on earth and the interrelations between organisms and their environment

2. To study the ecological and evolutionary basis for animal behavior and its role in enabling animals to adapt to their ecological niches.

UNIT – I

1. Introduction to Ecology and its various branches, Concept and Introduction to Limnology and Hydrobiology
2. Concept of Ecosystem, Homeostasis, Types of Ecosystems (Freshwater, Estuarine and Marine Ecosystem), Biotic and abiotic factors
3. Food Chain: Structure, Components, Interactions and Energy Flow in Forest Ecosystem, Reservoir Ecosystem & Marine ecosystem;
4. Concept of Productivity and Food web in reservoir ecosystem.

UNIT – II

1. Concept of habitat and ecological niche.
2. Mangrove Ecosystem and importance of Mangroves.
3. Population Ecology.
4. Ecological Succession.
5. Limiting Factors in Ecosystem.

UNIT-III

1. Introduction to Ethology.
2. Innate Behaviour: a) Taxis b) Reflexes c) Instincts
3. Acquired Behaviour- a) Learning b) Reasoning c) Memory
4. Colonial/Social Behaviour in Termites; structure of Termite Colony.

UNIT – IV

1. Mimicry in animals
2. Parental care in amphibians and higher animals
3. Pheromones in insects
4. Migration in Birds
5. Nesting behavior in Fishes and Aves
6. Remote sensing Tools and modeling for ecological and behavioral studies in animals

SUGGESTED READINGS

1. Ecology – Odum
2. Ecology and Environment – P. D. Sharma – Rastogi Pub., Merrut
3. Concept of Ecology - Edmond Cormondy, Himalaya Publishing house, Mumbai.
4. Ecology – M. P. Arora, Himalaya Publishing house, Mumbai.
5. Environmental Pollution, H. Loggen, - Holt Reinholt, Winston.
6. Noise Pollution and its control – T. N. Tiwari, V. P. Kudesia, Pragati Prakashan, New Delhi.
7. Environmental Relation, Thermal Pollution and Control – G. R. Chatwal, M. C. Mehera, Amol Publication, New Delhi.
8. Animal Behavior – Vinod Kumar, Himalaya Publishing House, New Delhi.
9. A Text Book of Animal Behavior – H. S. Gundevia, H. G. Singh. S. Chand and Co. Ltd.
10. Animal Behavior, An Evolutionary Approach – Alcock, Sinauer Assci. And Co. Ltd.
11. Animal Behavior – Boulanger
12. A text book of Animal Behavior – Harjinder Singh, - Amol Pub. Pvt. Ltd, New Delhi.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – III (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper
Paper Code: BTT/BOT/ZOT- 301
Title of the Paper – Recombinant DNA Technology
Total Credits – 04, Number of Periods – 60

Scope

The paper is introduced to familiarize the students with all practical tools and molecular techniques like DNA sequencing, restriction mapping and PCR for creating recombinant DNA molecule and transforming in the appropriate host cell to check the expression of recombinant DNA.

Unit I

1. Principles, Scope and methods in Genetic Engineering.
2. Milestones in Genetic Engineering, Genetic engineering guidelines.
3. Molecular Tools and their Applications: Restriction enzymes, modification enzymes, DNA and RNA markers.
4. Isolation and purification of chromosomal and plasmid DNA, Yield analysis, Nucleic acid amplification and its applications.

Unit II

Gene Cloning vectors: Properties and Applications

1. Plasmids, bacteriophages, phagemids, cosmids.
2. Artificial chromosomes. Restriction mapping of DNA fragments and map construction.
3. Nucleic acid sequencing. cDNA synthesis and Cloning, reverse transcriptase, DNA primers, linkers, adaptors their uses and chemical synthesis.
4. cDNA and Genomic library construction and methods for screening.
5. Alternative strategies of Gene Cloning: cloning interacting genes – Two and three hybrid systems,
6. Nucleic acid microarray and its applications.

Unit III

Study of gene Expression and regulation

1. Northern blot, Primer extension, S1 mapping, Rnase protection assay,
2. Reporter assays. Expression strategies for heterologous Gene expression: Vector engineering and codon optimization, host engineering,
3. *In vitro* transcription and translation, expression in bacteria, expression in mammalian and plant cells,
4. Processing of Recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

5. Process and applications of Phage Display.

Unit IV

Gene Tagging and Gene Therapy

1. T-DNA and transposon tagging, identification and isolation of genes through T-DNA or transposon.
2. Transgenic and Gene knockout technologies. Principles of Gene therapy: Vector engineering. Strategies of gene delivery.
3. Gene replacement/augmentation therapy, success and limitations of gene therapy.

Recommended Books:

1. Molecular Cloning: A Laboratory Manual, J. Sambrook, E. F. Fritisch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. DNA Cloning: a Practical Approach, D. M. Glover and B. d. hames, IRL, Press, Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, P. B. Kaufman, W. Wu, D, Kim and L. J. Cseke, CRC Press, Florida, 1995.
4. Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, S. L. Berger and A. r. Kimmel, Academic Press, Inc. San Diego, 1998.
5. Methods in Enzymology Vol 185, Gene ExpressionTechnology, D. V. Goeddel, Academic Press, Inc., San Diegoo, 1990.
6. DNA Science. A First Course in Recombinant Technology, D. A. Mickloss and G. A. Freyer, Cold Spring Harbor Laboratory Press, New York, 1990.
7. Molecular Biotechnology (2^{nd} edition), S. B. Primrose, Blackwell Scientific Publishers, Oxford, 1994.
8. Milestones in Biotechnology. Classic papers on Genetic Engineering, J. A. Davies and W. s. Raznikoff, Butterworth-Heinemann, Boston, 1992.
9. Route Maps in Gene Technology, M. R. Walker and R. Rapley, Blackwell Science Ltd., Oxford, 1997.
10. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, S. M. Kingsman and A. J. Kingsman, Blackwell Scientific Publications, Oxford,1998.
11. Molecular Biotechnology – Glick.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – III (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper
Paper Code: ZOT-302
Title of the Paper – Biostatistics & Bioinformatics
Total Credits – 04, Number of Periods – 60

Biostatistics and Bioinformatics

Scope

1. The objectives of this paper are to describe how molecular data is useful to understand the genome complexity for organization using bioinformatics based software/ tools.
2. Biostatistics aims to develop competently and expertise in the application of statistical methods applied to biological data obtained in experimental techniques.

Unit I

1.Introduction, its role and uses of Biostatistics.

2.Collection; Organization; Graphic and pictorial representation of data.

3. Measures of central tendencies and dispersion.
4. Coefficient of variation.
5. Probability: Basic concepts; Common probability distribution and probability distribution related to normal distribution.
6. Sampling: Simple random and other sampling procedures; Distribution of sample mean and proportion.

Unit II

1.Estimation and Hypothesis testing: Concepts of hypothesis testing and types of errors.

2. students t and Chi- square tests.

3. sample size and power.
4. Experimental design and analysis of variance.
5. Correlation and regression: Graphical presentation of two continuous variables. Multiple and partial correlation, Linear regression; Regression line;
6. Coefficient of determination; Interval estimation and hypothesis testing for population slope.
7. Experimental design in clinical trials; Parallel and crossover designs; Statistical test for bioequivalence; Dose response studies.
8. Statistical quality control.

Bioinformatics-2 Credits

Unit III

Bioinformatics basis:

1. Computers in biology and medicine.Database concepts,
2. Protein and nucleic acid databases; Structural databases; Computational tools for DNA sequences analysis, MEGA; Resources on CSB.

Databases and search tools:

1. Biological background foe sequence analysis.
2. identification of protein sequences from DNA sequences.
3. Searching of databases similar sequences; NCBI.
4. publicly available tools; Resources at EBI. Resources on the web.
5. Database mining tools.

Unit IV

DNA Sequences analysis:

1. The gene bank sequence database; submitting DNA sequences to the database (NCBI-Banklt , SEQUIN) and database searching.
2. Sequences alignment; Pair wise alignment techniques;
3. Multiple sequences analysis; Multiple sequences alignment.

Peptidomimetics:

1. Introduction, classification; pseudopeptides, Biologically active template; amino acid replacement.
2. CADD techniques in peptidomimetics; Development of non peptide peptidomimetics.

Recommended Books:

1. P. Rama Krishna ,Biostatistics, Saras Publication, 1995.
2. Vittal R. Srinivas ,Bioinformatics: A modern approach,. Prentice-Hall India Pvt. Ltd.
3. T. K. Attwood and D. J. Parry-Smith ,Introduction toBioinformatics, Pearson education 2004.
4. S. C.

5. Rastogi, N. Mendiratta, P. Rastogi ,Bioinformatics: Methods and Application, Genomics, Protomic and Drug Discovery, Prentice-Hall India Pvt. Ltd. 2004.
6. P.S.S. Sundar Rao,P.H.Richard, An Introduction to Bio-statistics, Prentice Hall of India (P) Ltd.New Delhi,2003
7. Gupta S.P., Statistical Methods, sultan Chand and Sons, New Delhi,2005.
8. Jerrold H.Zar, BioStatistical Analysis, Asia Publishing Co., New Delhi, 1962.
9. David W. Mount, Bioinformatics: Sequence and Genome Analysis 2nd Edition,CSHL Press,2004.
10. Baxevanis and F.B.F.Ouellette, Bioinformatics: a practical guide to the analysis of gene and proteins,2nd Edition, John Wiley, 2001.
11. Jonathan Pevsner, Bioinformatics and Functional Genomics, Ist Edition, Wiley,2008.
12. C.Branden and J.Tooze, Introduction to protein Structure, 2nd Revised Edition Garland Publishing, 1998.

S.R.T.M. University, Nanded,

Department of Life Sciences

M. Sc. Zoology, Semester – III (Year 2017 Onwards)

Choice Based Credit System)

Syllabus- Theory Paper

Paper Code: ZOT- 303

Title of the Paper – Applied Zoology

Total Credits – 04, Number of Periods – 60

Scope

The paper is designed to deal with the applications of various life forms in well being of human life which has a direct role in the protection of environment, food, clothing and medicines

UNIT – I

1. Introduction to Economic Zoology.
2. Pond culture fishery – Pond construction and management, Fish seed purchase/Production and stocking, Fish harvesting and marketing.
3. Reservoir fishery – Types of reservoir, Getting the reservoir on lease and tender system.; Use of reservoir for fish seed stocking and fishery. Management, Harvesting of fish using nets, gears and boats, rafts. Transportation and Marketing of fish catch.
4. Poultry-Duck-cum fish culture.
5. Paddy-cum fish culture.

UNIT – II

1. Lac Culture,
2. Honey bee keeping,
3. Sericulture, Pearl culture,
4. Crab & prawn culture,
5. Biotherapy: Fish therapy, Maggot therapy, Leech therapy.

UNIT – III.

1. Pig farming (Species, Shelter, Food, Health management, Growth, Reproduction, Use and Marketing. Expenditure and income balance sheet)
2. Cattle farming –(Lal Kandhari and Deoni Breeds: Shelter, Food, Health management, Growth, Reproduction, Use and Marketing. Expenditure and income balance sheet.
   Buffalo farming (Murha, Jafrabadi: for milk,
3. Goat farming.
4. Introduction to Biodiversity Protection Act, Govt. of Maharashtra, 2002

UNIT - IV

1. Construction of aquarium and accessories required.
2. Aquarium fish species – characters, food, reproduction, culture and maintenance (any five Species). Aquarium Maintenance.

3. Marketing of aquarium and aquarium accessories.
4. Preparation and Applications of compost and vermicompost.
5. Parasitic nematodes : Ascaris lumbricoid: health hazard, prevention and treatment. and Cestodes (*Taenia solium, Taenia saginata*: health hazard, prevention and treatment.
6. Common Pests of Soybean and Cotton (One each): Control and Management.

UGGESTED READINGS

1. Economic Zoology – K K C Vishwas
2. Fish and fisheries of India - C. Jhingran – Amol Publishing house, New Delhi.
3. Tropical Fish Farming – Belsare, Daya Publishing , New Dilhi.
4. Aquatic Sciences in India – B. Gopal, V. Asthana - Daya Publishing , New Dilhi.
5. Fishery products and processing – W. Horner. Daya Publishing , New Dilhi
6. Fisheries Science – R. Santhanam. Daya Publishing , New Dilhi
7. Freshwater zooplankton of India – Battish S. K. Daya Publishing , New Dilhi.
8. Agricultural Economics – Drummond H. E. Daya Publishing , New Dilhi
9. Dairying in India H. C. Gupta. Daya Publishing , New Dilhi
10. Bees and Bee keeping- Abrl D. P. Daya Publishing , New Dilhi
11. Applied animal Nutrition – Cheeka P. R. Daya Publishing , New Dilhi
12. Bee keeping – Carter G. A Daya Publishing , New Dilhi
13. Cattle Fertility and sterility – Asdell S. A. Daya Publishing , New Dilhi
14. Common diseass of companion animals – Summers A. Daya Publishing , New Dilhi
15. Dairy Bovine Production – Thomas C. K. Atlas Books and Periodicals, New Delhi
16. Essentials of Animal Production and Management – Singh R. Atlas Books and Peri, New Delhi
17. Goat, Sheep and Pig – Production and Management – Prasad J. Atlas Books and Peri, New Delhi
18. A Handbook of Aviculture Woolham F. Atlas Books and Periodicals, New Delhi
19. Economic Zoology – Blackwell. Atlas Books and Periodicals, New Delhi
20. Handbook of Poultry Nutrition. Atlas Books and Periodicals, New Delhi
21Aquaculture and Aquarium Keeping – S. P. Chavan, M. S. Kadam and S. D. Niture, Educational Books and Publishers, Aurangabad
22. Introduction to Animal Science – Rare S. Atlas Books and Periodicals, New Delhi.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – III (Year 2017 onwards)
(Choice Based Credit System)
Syllabus- Theory Paper -304
Paper Code: ZOT- 304
Title of the Paper–Environmental Pollution & Toxicology
(Total Credits – 04, Number of Periods – 60)

Scope:

1. To create awareness about environmental health
2. To impart knowledge about environmental toxicants.
3. To study the adverse effects of chemical, physical or biological agents on living organisms and the ecosystem, including the prevention and amelioration of such adverse effects.

UNIT – I

1. Introduction and Scope of: Environmental pollution, Toxicology, Toxicity, Xenobiotics.
2. Hazardous & Non hazardous substances, Persistent organic pollutants,.
3. Bioremediation,Bioconcentration,Bioaccumulation,Biomagnification, Biomarker & Indicator organisms, Risk assessment.
4. Classification of toxicity, Types of toxic agents, Classification, mode & mechanism of action of pesticides, Metals, Solvents, Radioisotopes.
5. Carcinogens & their biological effects on ecosystem and human health.

UNIT – I

1. Air pollution & Climate: Acid rain, Ozone depletion, Photochemical smog, Aerosols, Green house gases & their effects on vegetation, animals & human health. control measures in air pollution.
2. El-Nino effect.
3. Aquatic Pollution: Heavy metals, Oil spills, POPs.
4. Thermal & Radiation effects on biological systems.

UNIT – III

1. Effects of pollutants on physiology of Digestion, Respiration, Circulation & Excretion.

2. Principles of Ecotoxicology and Genotoxicity.

UNIT – IV

1. Characteristics of Waste Water, Physical, Chemical & Biological treatment of waste water.
2. Ecofriendly methods of solid waste management.
3. Instrumental and Statistical methods in Toxicological studies.
4. Environmental impact assessment, Environmental policy, Regulatory toxicology, Residue analysis.
5. Human toxicology & Medical ethics.

SUGGESTED READINGS

1. Ecology – Odum.
2. Ecology & Environment – P.D Sharma, Rastogi publication, Meerut,India.
3. Introduction To Animal Ecology & Environmental Biology – H.R Singh, S.L.N Chand & co. Jalandhar, Delhi.
4. Ecology – M.P Arora,Himalaya publishing house,Mumbai.
5. Concept Of Ecology – Edward J.kormondy, Himalaya publishing house,Mumbai.
6. Enviromental Pollution – H.Loggen Holt Reinhort Wintson (1978).
7. Air Pollution - Physical & Chemical fundamentals – J.H Seinfield, M.C GrawHill, Newyork (1975).
8. Noise pollution & it's control – T.N.T iwari, V.P Kudesia, Pragati Prakashan, New Delhi (1990).
9. Envirnmentai Radiation, Thermal pollution & Control – G.R Chatwal, M.C Mehra, Amol publication, New Delhi.
10. Limnological Methods – P.S Weltch, M.C GrewHill,N.Y.
11. Fresh Water Biology – Ward & Whipple, John willy,N.Y.
12. Biology Of Polluted Water – H.B.N Hynes,Liverpool University Press.

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – IV (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper - 401
Paper Code: ZOT- 401
Title of the Paper – Animal Physiology and Endocrinology
Total Credits – 04, Number of Periods – 60

Scope: This paper helps in understanding how the body functions and adapts with respect to its external & internal environments related to nervous integration, sensation, metabolism & reproduction.

UNIT – I

1. General Organization of alimentary canal – Role of salivary glands, liver, pancreas & intestinal glands in digestion.
1. Digestion and Absorption of proteins, carbohydrates and lipids and its hormonal regulation. Pancreatic hormones and their role in digestion. Details on Diabetes.
2. **S**tructure of mammalian kidney–Urine formation- acid base regulatory mechanisms. Endocrine regulation of water & mineral balance.
3. Nitrogenous and non-nitrogenous excretory products in animals. Urea cycle.

UNIT– II

1. Composition of blood, Blood group in man, Blood Coagulation. Osmoregulation and mechanisms.
2. Structure of mammalian heart and its working. Open & closed system of circulation.
3. Types of muscles – Ultra-structure-Mechanism of contraction of skeletal muscles. Nervous control of muscles.
4. Nerve conduction- Synapse-Neurotransmitters- Nervous co-ordination-Coding information to sensory organs.
5. Gametogenesis, Reproductive cycle and Physiology of reproduction in mammals,

UNIT-IV.

1. Hormones, Neuro-hormones, Neurotransmitters. Physiology of Hormone action.
2. Pituitary gland, Thyroid gland, Parathyroid gland and Adrenal gland: Structure, hormones and their functions.
3. Thyroid hormone synthesis and its regulation, Physiology of Goiter.

4. Hormones and calcium metabolism in vertebrates.
5. Hormones and coloration , color changes in crustaceans and Fishes.
6. Endocrine system in a crustacean.
7. Endocrine glands hormones and their functions in fishes.
8. Structure of endocrine system and hormones in insects.
9. Hormonal regulation of reproduction, molting and development in insects
10. Parthenogenesis.

References:

1. Ganong, H, Review of Medial Physiology, 1989. 14th edition, Appleton &Lange publisher, New York

2. Physiology: A regulatory system approach, Fleur, and Strand, (1978). Macmillan Publishing Company, New York; Collier Macmillan Publishers, London.

3. Shier, D., Butler, J. and Lewis, R., Hole‟s Human Anatomy and Physiology, (10th edition) 2003. WCB/McGraw Hill, Boston. 2003.

4. Animal Physiology, EcKert, R (5th edition), 2002. W.H.Freeman.

5. Williams S. Hoar (1991) General and Comparative Physiology 3rd edition. Prentice Hall of India- New Delhi.

6. Neilson, K.S. Animal Physiology, 1997. Cambridge University Press, Pergamon Press, Oxford.

7. Prosser, C.L. and Brown-Jr. F.A.: Comparative Animal Physiology, 1961. W.B. Saunders, Philadelphia.

8. Nagabhushanam, Kodarkar & Sarojini. Animal Physiology

9. A Text Book of Comparative Vertebrate endocrinology – P. J. Bentley – S. Chand and co. New Delhi.

10. Comparative vertebrate Endocrinology – Gorbman and Ber n – ELBS Publishers, London, New York.

11. Comparative Vertebrate Endocrinology – Turner – ELBS Pub.

12. Endocrinology of Reproduction – Nalbandhu.

13. A Text Book of Animal Physiology – Nagbhushnam, Kodarkar and Sarojini – Oxford and IBH Co. New Delhi.

14. Fish Endocrinology – J. M. Matty.

15. Invertebrate Endocrinology – Hyman L. H.

16. Fish Endocrinology Vol. – I- VI, Hoar and Randall.

17. Invertebrate Endocrinology by Highnam & Hill

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – IV (Year 207 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper - 402
Paper Code: ZOT- 402
Title of the Paper – Fish Biology and Aquaculture
Total Credits – 04, Number of Periods – 60

Scope

The syllabus is designed to equip and train the students to understand about fish biology and processes, the importance of culture practices and processes involved in preservation and marketing of fish and other edible organisms and the products derived from them.

UNIT – I

1. General Characters and Classification of Fishes up to important orders.
2. Morphometric and Meristamatic Characters in fishes.
3. Structure and functions of Weberian ossicles in fishes.
4. Structure and functions of Air Bladder in fishes
5. Osmoregulation in Teleosts and Elasmobranchs and its Hormonal control.
6. Introduction to Food, feeding habits, gill rackers and digestive system in teleosts.
7. Structure of heart and blood circulation in teleost
8. Structure and functions of electric organs in fishes.

UNIT-II

1. Introduction to freshwater fish culture: Monoculture, Raceway culture, Cage culture, Pen culture, Culture of air breathing fishes (*Heteropneustus, Clarius, Channa, Anabas*)
2. Structure and working of Chinese Hatchery system for fish seed production
3. Induced breeding of fishes. Bundh Breeding.
4. Fish seed measurement, Packaging, transportation, release in reservoirs or culture ponds.
5. Pond Fishery: Pond construction and Management. Mixed fish farming of Indian Major carps and Exotic carps.
6. Prawn Fishery.

UNIT – III

1. Fish Biology methods: Assessment of spawning periodicity by Ova-diameter measurement, Weight length relationship study, Ponderal Index; Scale method for assessment of fish age and growth.
2. Different methods of fishing. Nets and Boats used to catch the fishes from culture pond, reservoirs, sea and other water resources.

3. Processing and preservation and packaging of freshwater and marine water fishes.
4. Fish products and by-products
5. Biochemical composition of raw fish and Nutritional value
6. Post-mortem changes, Rigor Mortis and spoilage of fishes
7. Structure and working of fish cooperative society in freshwater and marine capture fishery.

UNIT – IV

1. Introduction to EEZ and Marine fisheries resources. Remote sensing applications in Marine fisheries of India.
2. Study of Principal freshwater & marine fisheries – (Distribution, Biology, Food and feeding, reproduction, nets, boats, gears used, processing and use): Oil Sardine. Bombay-Duck. Mackerel. Molluscs.

Reference Books

1. Bardach, et. Al. Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
2. Stickney, R.R. Principles of Water Aquaculture. John Wiley & Sons, NY, 1979.
3. Chondar, C.L. Hypophysation of Indian major carps. Satish Book Enterprise, Agra, 1980.
4. Jhingran, V.G. Fish and fisheries of India. Hindustan Publ. Corporation (India), 1982.
5. Santhanam, R. et. Al. A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
6. Pilley, T.V.R. Aquaculture – Principles and Practices. Fishing News (Books) Ltd., London, 1990.
7. Pandey, A.C. Air Breathing Fishes. Reliance Publishing House, New Delhi, 1990.
8. Janardhana Rao, K. & S.D. Tripathi. A Manual of Giant Freshwater Prawn Hatchery. CIFA, Kausalyaganga, Orissa, India, 1993.
9. Iso Matsui. Theory and Practice of Eel Culture. American Publishing Co. Pvt. Ltd 1980.
10. Aquaculture and Aquarium keeping- S. P. Chavan, M. S. Kadam, S. D. Niture. Educational Books Publishers and Distributors, Aurangpura Aurangabad, MS
11. A Manual of Fresh Water Aquaculture, Santhanam. Oxford and IBH Publishers and Distributors New Delhi.
12. Introduction to Fishes – S. S. Khanna, Central Book Depot, Allahabad
13. Taxonomy of fishes – Jhingran and Talwar
14. Physiology of fishes – Hoar and Randall.
15. Fish Biology and Indian fishes – R. P. Parihar, - Central publishing house, Allahabad.
16. A text book of fish, fisheries and Technology, Biswas – Narendra Publishing House, New Delhi.
17. Aquaculture and Aquarium Keeping – Chavan S. P., Kadam M. S. and Niture S. D., - Educational Books and Publishers, Aurangabad, M. S.
18. Fishery Science and Indian Fisheries – C. B. L. Shrivastava - Kitab Mahal, New Delhi.
19. Aquaculture Principles and Policies – T.V.R. Pilley – Daya PublishingHouse, New Delhi
20. Aquaculture and Practices a selected review – FAO
21 Aquaculture Project Formulation – FAO
22. Bacterial Diseases of Fishes – Veleri Englis Ronald – Daya Publishing House New Delhi.
23. Taxonomy of Fishes Vol I, Vol II – Francis Day (Narendra Publishing House New Delhi)
24. Marine Fisheries – Bal and Rao

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – IV (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper
Paper Code: ZOT- 403
Title of the Paper – Animal Biotechnology
(Total Credits – 04, Number of Periods – 60)

Scope

To familiarize the use of the data and techniques of engineering and technology in biology for the study of living organisms, or derivatives of thereof, to make or modify products or processes for specific use. Also, to find solution of problems concerning human activities including agriculture, medical treatment, industry and environment.

Unit-1 15 hours

1. Animal Cell & Tissue Culture: Historical Background, Development, Advantages and limitations of cell and tissue culture and applications.
2. Application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.
3. Requirements, Aseptic techniques and Media: Aseptic Area, Incubation, Preparation and Sterilization, Storage and specialized equipment, Consumable items, Elements of aseptic environment, sterile handling and Laminar Flow. Culture Vessels and treated surfaces.
4. Define Media and Supplements: Physicochemical Properties, Balanced Salt Solutions, Media, role of serum and serum free media.

Unit-II 15 hours

1. Primary and Secondary culture of animal cells: Types of Primary cell culture, Isolation of the tissue and primary culture;
2. Subculture and propagation, Criteria of subculture, Growth Cycle and split ratio, Propagation and sub culture in suspension,
3. Scale up and large scale production of cells using bioreactors, micro-carriers and perfusion techniques.
4. Cell lines and need for characterization of cells.

Unit-III 20 hrs.

1. Model animals in animal biotechnology.
2. DNA transfer techniques into mammalian cells: Calcium Phosphate Precipitation, DEAE dextran procedure, Microinjection, Electroporation, Viral vectors for gene transfer into mammalian cells.

3. Artificial insemination, Super-ovulation, IVF, Somatic Cell Nuclear Transfer, and Stem Cell Technology

Unit-IV 10 hours

1. Concepts of Animal Cloning, Principles of cloning and applications of animal cloning.
2. Models used in animal genomics.
3. Livestock in the post genomic era of biology and medicine.
4. Principles of tissue engineering.
5. Gene therapy, animal ethics and Bio-safety.

SUGGESTED READINGS

1. Gordon I. 2005. Reproductive Techniques in Farm Animals. CABI.
2. Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. New Generation Vaccines. 3rd Ed. Informa Healthcare.
3. Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.
4. Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.
5. Nalwa HS. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.
6. Niemeyer CM & Mirkin CA. 2005. *Nanobiotechnology*. Wiley
7. Animal Cell Culture: John R W Masters
8. Animal Cell Culture Methods: In Methods of Cell Biology, Jenni P Mather and David Barnes
9. Culture of Animal cells – R Ian Freshney
10. Biotechnology Vol. 7b Rehm H J and Reed, G.
11. Molecular Biotechnology: Principles and Applicationsof recombinant DNA Technology – Glick and Pasternak
12. Biotechnology and Applications: Nagabhushanam R., Diwan A D and Gyananath G

S.R.T.M. University, Nanded,
School of Life Sciences
M. Sc. Zoology, Semester – IV (Year 2017 Onwards)
(Choice Based Credit System)
Syllabus- Theory Paper
Paper Code: ZOT- 404
Title of the Paper – Parasitology
(Total Credits – 04, Number of Periods – 60)

Course Objectives: The basic and general concepts of Parasitology is to study the major types of parasites of medical & veterinary importance. Basics of identification of common parasites of humans and animals. To design and evaluate an intervention to control food and waterborne diseases. Critically read and evaluate epidemiologic studies in the different disease. Critically read and evaluate epidemiologic studies in emerging disease and bioterrorism literature and its control, management. To develope the experts in Medical and veterinary Parasitology.

UNIT-I

1. Introduction to Parasitology, Parasitism- Definition & concept. Types of Parasites. Factors influencing Parasitism; Influence of season, host age and other phonological factors on parasitic population (prevalence, intensity etc).
2. Inter-specific biological relationships phoresis, symbiosis, Commensalisms and parasitism.
3. Origin and evolution of parasites and adaptation in parasites. Advantages and Disadvantages in parasitic life.
4. Types of hosts- Definitive and intermediate, primary secondary specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental, Vectors, Host specificity.
5. Major taxa of parasites of medical & veterinary importance.

UNIT-II

1. Parasite and global public health. Global burden of infectious diseases.
2. Parasitic zoonosis.
3. Introduction to Immunology of Parasitic infections. Natural & acquired immunity. Immunodiagnosis.
4. General principles of immunization and Hypersensitivity reactions.
5. Strategies in designing parasitic vaccines and Limitations.
6. General organization of the parasitic Protozoa occurring in urinogenital tract and blood.
   a. i) *Trichomonas vaginalis*
      ii) *Trichomonas foetus*
   b. i) *Trypanosoma gambiense*

ii) *Trypanosoma cruzi*
iii) *Leshmania donovani*
iv) *Leshmania tropica*

UNIT-III

1. Study of medically and veterinary important Parasitic Cestodes: Intestinal cestodes. Tissue cestodes.
2. Study of medically and veterinary important Parasitic Trematodes: Trematodes infective in Metacercarial stage. Trematodes infective in Cercarial stage
3. Special features of Apicomplexa
4. Life cycle and pathogenecity of malarial parasites and control on malaria.
5. Study of coccidian parasites in vertebrates.
6. Study of class Piroplasma to special reference to *Theleria* and *Babesia*
7. Study of medically and veterinary important Parasitic Nematodes: Intestinal nematodes infective in egg stage, Intestinal nematodes infective in larval stage.
8. Blood & tissue dwelling nematodes.

UNIT-IV

Morphology life history, diseases/ harm caused and the control of following-

a) Parasitic Acanthocephala and Annelida (Any one example each)
b) Parasitic Siphonoptera, Anupleura, Mallophaga.
c) Parasitic Diptera
d) Parasitic Hemiptera and Pentastomidea
e) Parasitic Crustacean and Acarids (any one example).

List of books for Applied Parasitology (ZOO 525 and ZOO 535)

The following texts are necessary for comprehension of the course topics:

1. 'Infectious Disease Epidemiology: theory and practice' 2nd edition. Nelson & Williams (Eds.). 2007.
2. A good additional online text: Global Burden of Disease and Risk Factors. Disease Control Priorities Project. It is available at: http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=gbd.TOC&depth=2
3. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co.
4. Reingold, A.L. Outbreak Investigations – A Perspective. Emerging Infectious Diseases 1998; 4(1): 21-27.
5. Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. and P. Daszak. Global trends in emerging infectious diseases. Nature 2008; 451(21): 990-993.

Reference Books

1. The Trematode - Dausese B
2. Text book of medical parasitology -Dey
3. Text book of medical parasitology -Sawitz
4. Parasitology -Nobel and Nobel
5. Structure of Nematode - Allenbird
6. An introduction to Nematodology -Chitwood

7. Organization of nematodes - Crool
8. Biology of nematode - Crool
9. Physiology of nematodes - Lec
10. Plant parasitic nematode - Parmonove
11. Principal of nematodology - Throne
12. Plant nematodology - Jenkin and Taylor
13. Clinical parasitology - Craig Faust
14. Applied parasitology - Hiware, Jadhav and Mohekar
15. Biochemistry of parasitisims - Von Brand
16. Physiology of cestode parsitology - Smith
17. Physiology of nematode parasite - Smith
18. Helminth, Arthropod and Protozoa of domesticated animal -Solbsy E.J.W
19. Laboratory methods of work with plant and soil nematodes -Southey
20. Human helmintology Munual for Clinicals, Sanitarians Medical Zoologists –Faust, Emerest Caroll.
21. Soil and fresh water Nematodes - Goodey.
22. The Invertebrates Vol. II -Hyman L. H.
23. Practical exercise in Parasitology -Halton, Behave, Marshall.
24. Animal Nematodes from Indian Mammals -Nama, Shinde and Jadhav.
25. Cestodes from Indian fishes -Baba Jadhav.
29. Chatterjee K. D. (1969) -Parasitology (Protozoology and Helminthology)

30. Cheng T.C. (1964)-The Biology of animal parasites, Saunders International Student Edition.
31. The Invertebrates Vol II, McGraw Hill, New York.- Dawes B. (1946).
32. Text book Medical Parasitology of Jaypee Brothers, - Panikar C.K.J (1988) Medical Publishers, New York. - Panikar C.K.J (1988)
33. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977)
34. Parasitology (Protozoology and Helminthology) -Sood Pamnik (1993) CBS Publication and Distrubution, Delhi.
35. Systema helminthum Vol. IV Monogenea and Aspidobothria - Yamaguti S. (1963) Inter- Science Publishers, London.
36. Synopsis of Digenetic Trematodes of Vertebrates - Yamaguti S. (1971) Vol. I & II Keigaku Publishing Co., Tokyo, Japan.
37. The Zoology of Tapeworm. - Wardle and Mcleod (1952)
38. The advances in the Zoology of tapeworm from - 1970- Wardle and Mcleod
39. Systema Helmenthum Vol. II Cestoda. - Satyu Yamaguti (1959)
40. The Physiology of Cestodes. - J.D Smyth
41. Vertebrate Nematodes - York and Mapelston
42. Plant Parasitic Nematodes, bionomics & control - Cristie
43. Soil and fresh water nematodes. - Gobbey
44. Laboratory Methods for work with plant and soil Nematodes. - Southeu
45. Parasitic Protozoa - Baker
46. Clinical Parasitology - Beaver, Jung & Cupp
47- An Introduction to Parasitology - Chandler and Read
48- Modern Parasitology - Cox
49- An Introduction to Protozoology - Dogiel
50- Chemical Zoology Vol I Florkin and Sheer
51- Protozoology - Grell
52- Protozoology - Hall
53- The Coccidia - Hammond and Long
54- Parasitic Protozoa Vol, I-II - Krier et al

55- Protozoology - Kudo
56- An Introduction to Prozoan Parasities of domestic animals and man - Levine
57- An Introduction to Protozoa - Manwell
58- Essential Parasitology -Scmidt
59- Biology of Protozoa - Sleigh
60- Parasitism - Cameron
61- Animal Parasitism - Read
62- Parasitism and Symbiology - Read
63- Physiology of nematode parasites - Bee
64- Bio- Chemistry and physiology of protozoa II Ed. Vols I and II. -Hutner and Lwoff
65-Prozoan Parasites of domestic animals and man - Levine
66- Nematodes Parasites of domestic animal - Levine
67- Structure of Nematodes - Bird
68- Medical Parasitology (Protozoology and Helminthological)- Chatterjee K. D

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
List of Laboratory Exercises for M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-1

Credits4 **Marks - 100 Marks**

1. Determination of Blood group in human.
2. Estimation of Blood Cells, Blood cell count.
3. Separation of serum from Blood sample by centrifugation.
4. To determine the antigen antibody reaction by gel diffusion.
5. Separation and Identification of RBC, WBC, and Microphages from blood by using electrophoresis method.
6. To determine the blood clotting time.
7. Separation of amino acids by paper chromatography method.
8. Separation of antigen antibody by gel electrophoresis.
9. Solution Preparation, understanding Molarity, Normality, buffer, pH Meter
10. Amplification of DNA by using PCR Tools.
11. Experiments on enzyme activity (Amylase, Protease, Lipase, inhibitors)
12. Verification of Lambert Beer Law.
13. Estimation of Reducing/Non-Reducing sugars by colorimetry/Spectrophotometry
14. Separation and identification of amino acids from given amino acid sample by paper chromatography.
15. Separation and identification of sugars by Thin Layer Chromatography (TLC). Introduction to Gas Chromatography (GC).
16. Separation of amino acids and proteins by polyacrylamide Gel Electrophoresis ((PAGE)
17. Introduction and uses of HPLC

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
List of Laboratory Exercises for M. Sc. Zoology, First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course – 2

Credits-4 **100 Marks**

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1. Study of Osmotic stress on cell membrane.
2. Cell organelle separation by Centrifugation: Nucleus. Mitochondria, Chloroplast
3. Cell division study- Mitosis and Meiosis,
   Onion/Garlic root tip, Grasshopper testis, snails.
4. Microscopic study of structure of sperms.
5. Study of semen for sperm motility and abnormalities.
6. Micro techniques for histology and histo-chemistry of tissue preparation.
7. Study of developmental stages in fertilized egg of hen.
8. Study of regeneration in earthworms and cultivable fishes.
9. Preparation and submission of five slides of cells isolated from different organs of invertebrate and vertebrate animals.
10. Techniques of cryopreservation of eggs and sperms
11. Computer simulated experiments in animal embryology and cell biology.
12. Problems based on gene linkage, sexed linked inheritance and crossing over.
13. Isolation of genomic DNA/RNA from Bacteria, animal and plant cells.
14. Isolation of plasmid DNA by using alkaline lysis method.
15. Isolation of antibiotic resistance practical by gradient plate method.
16. Replica plating for transfer of bacteria colony.
17. Study of in-vitro transcription and translation using PCR.
18. Study of mutation in microbes/fungi by Ames Test.
19. Computer Simulated Experiments.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
List of Laboratory Exercises for M. Sc. Zoology, First year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course – 3

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1. Equipments and collection methods for the invertebrates and vertebrates from terrestrial and aquatic habitats.: Protozoa, Helminths, Arthropods, Fishes.
2. Taxonomic study and taxonomic preparation of Insects, Parasites, Fishes and higher vertebrates.
3. Soft copy documentation of animals for taxonomic studies.
    a. Use of still camera and Video-camera, Use of Infrared night vision camera, Sound recording in animals & Underwater camera.
4. Study of local fauna for the taxonomy, distribution and conservational status and their preservation.
5. Studies on fossils, living fossils and connecting links Archaeopteryx, Peripatus, Limulus, Nautilus, Latimeria.
6. Practical methods of preservation and processing of animals, body parts and tissue samples-(Chemicals, preservatives and different processes)
7. Structure, types, management and maintenance of Museum and aquarium.
8. One long distance study tour preferably to the sea coast, to observe the animals in their natural habitat and report writing/Seminar.
9. Problems and exercises in phylogeny of model organisms.
10. Demonstration of following organs/systems from any teleosts (Food Fish) for the study of Heart and afferent branchial arteries, Cranial nerves, Weberian ossicles, Air Bladder & Gill rakers.
11. Virtual dissection of Rat and Frog (Computer Simulated demonstrations and Problems)
12. Museum study- based on Photo and /or models of the animals: minimum any two from each Class/Phyla given below.

a. Protozoans- for the structural differences and habitat specificity, locomotory organelles; Porifera spicules; Typical colony of Coelenterata; Arthropoda; Echinoderms; Cestodes, Trematodes, Nematodes and Molluscs.

b. Pisces- Photo/models/specimen- *Zygaena*, Stingray, Electric Ray, *Channa sp. , Catla catla, Wallago attu, Notopterus sp., Mastacembellus armatus, exocoetus, Echenius, Diodon, Hippocampus, Puntius sp.*

c. Amphibians- Photo/Model based study of *Ichthyophis sp., Rhacophorus sp., Hyla sp*.

d. Reptiles- Photo/Model based study of Chameleon sp., Phrynosoma sp., Varanus sp., Viper sp., Rat snake sp., Cobra sp., Turtle sp.

e. Aves- Photo/Model based study of Bubo, Duck, Vulture, Pigeon, Sparrow, Crow.

f. Mammals- Photo/Model based study of Loris Sp. Bat sp., Funambulus sp., Duuckbill platipus, Echidna, Kangaroo.

13. Mounting of scales in fishes for the structural differences.

14. Model or Photo based study of Horns in mammals and claws in birds.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
List of Laboratory Exercises for M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course–4

4 Credits 100 Marks

1. Ecology and Biodiversity of producers and consumers from terrestrial freshwater and marine ecosystem

-Unicellular/Filamentous algae: Aquatic weeds – Hydrilla, Ipomoea, Eichornia

-Marine phytoplankton & Marine Zooplankton; Grasshopper sp, Backswimmers, Beetle, Cotton Ball worm, Freshwater fishes, Amphibians, Calotes, Snakes & Birds

2. Estimation of N, P, K from the soil samples.
3. Quantitative estimation of plankton by Sidgewick Rafter counting cell method.
4. Experiments on productivity in Aquatic environment & Biomass estimation
5. Experiment on positive and negative photo taxis.
6. Parental care in animals: Ant, Hippocampus, Tilapia & Nest building of bird sp.
7. Computer Simulated Experiments on Ecology & Animal Behaviour.
8. Types of Media, its preparation and use.
9. To study the various equipments in microbial study- Wireloop, Micropipettes, Petriplates and its use.
10. Sterilization equipments and their uses un microbial study- Autoclave, Oven, laminar Airflow, Use of ethanol, fumigation of laboratory.
11. Isolation of bacteria from Fish gills/fish body and their gram staining.
12. Counting of bacteria from a petri plate by using colony counting method
13. Identification and uses of equipments for silk worm rearing.
14. Construction and maintenance of fish aquarium.
15. Insect pests of cotton and sugarcane.
16. Preparation of compost/vermi compost from agriculture and urban wastes using earthworm species & Biogas production.
17. Maintenance of Honey bee hives boxes and extraction of honey.
18. 0.xComputer Simulated/Demonstration of experiments in the field based on the curriculum.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
List of Laboratory Exercises for M. Sc. Zoology Second Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course - 5

4 Credits: 100 Marks

1. Introduction to the concept of gene bank, Protein bank and its application.
2. To determine and use the species data base of fish, birds, ants parasites.
3. Problems on Mean, Mode and Median
4. Problems on SD, SE and representation using computer using Excel program
5. Estimation of animal population structure using biostatistics- Similarity Indiex, Diversity Index, Richness, Evenness for Insects, Birds, Mammals.
6. Graphical representation of data. Problems and representation of results using Bar diagram, Pie charts, line diagram, histograms etc.
7. Use of ANOVA method and its application by using a suitable example, representation of results using computer.
8. Genetic recombination (Conjugation, transformation, transduction) in bacteria.
9. Restriction fragment Length Polymorphism in DNA (RFLP)
10. Random amplified Polymorphic DNA (RAPD).
11. Study of Southern hybridization.
12. Cloning in plasmid vectors and analysis of gene prodiucts.
13. Blotting and Hybridization techniques.
14. PCR Amplification.
15. Gene expression in E. coli.
16. Restriction, digestion and ligation of DNA.
17. Preparation of competent cells and transformation by CaCl2 method.
18. Agarose Gel electrophoresis by using DNA markers for molecular weight determination.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
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List of Laboratory Exercises for M. Sc. Zoology Second Year
(Choice Based Credit System) (Year 2017 Onwards)
Lab Course – 6

4 Credits: **100 Marks**

1. Identification of fishes with suitable examples from each class
2. Types of scales, fins, types of teeth, structure of alimentary canal, gill rackers, age determination in fishes.
3. Taxonomy and Biology of fishes from fresh water and marine water using computer assisted learning aids/specimen /model. *Labeo rohita, b. Catla catla, c Cirrihina mrigala, d. Cyprinus carpio, e. Labeo calbasu. f. Ctenopharyngodon idella g. Hypopthalmychthys molitrix, h. Tilapia sp. I) Notopterus kapirat j) Wallago attu k) Mastacembelus armatus l) Chimaera sp. M) Acipensor .0.0s.0p. N) Torpedo sp. O) Puntius ticto, p) Horpodon neherius q) Oil sardine, r) Mackeral s) Sole t) Pomfreet.*
4. Morphometrics and meristics in fishes for their taxonomy
5. Determination of growth, length and weight relationship and fecundity in fish.
6. Demonstration / Use of computer assisted digital programs/models/edible fish for determination of anatomical features of the following organs in fishes: Air Bladder, ii) Weberian ossicless III) Gill rakers , iv) Teeth v) Gonads vi) Heart vii) Ventral aorta and its branches brain and cranial nerves.
7. Study of models of fishing nets crafts and boats-i) Gill Net ii) Cast Net iii) Bag Net iv) Plankton net v) Different kinds of traditional and modern crafts and rafts used in fresh water and marine water. Vi) Mechanized Boats, Trawls. Vii) Sheep for fishing with advance technology- Echo sounder, light fishing, Electric fishing, GPs and Remote sensing applications in Fisheries.
8. Weight and length relationship and growth studies in fishes.
9. Field Visits/ Excursion tour to visit the Circular Chinese Hatchery of fish seed production/ Fishing Centre/Fish Market and submission of Report.
10. Air breathing organs in fishes.
11. Assessment of spawning periodicity by Ova diameter measurement.
12. Biological analysis of fish samples for gut contents, maturity stages and fecundity.
13. Examination of normal and diseased fish - Thorough examination of external surface, Autopsy of the diseased fish
14. Host examination – Collection of parasites, 4. Slide preparation - fixing - staining and mounting of parasites. Histopathology of organs of diseased fish (Sectioning – Staining and Mounting). Slides of fish parasites (Protozoan – Helminth and Copepod
15. Fieldwork: Visit to fish landing and processing centres, Visit to aquaculture farms, finfish and shellfish hatcheries, Visit to conventional aqua farm to see the management of used water. Survey on environmental impact nearby aquaculture farms; Setting model for sustainable aquaculture (organic farm, integrated farm).
16. Applications of remote sensing and GIS (geographical information system); Economic evaluation of aquaculture practices.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
List of Laboratory Exercises for M. Sc. Zoology Second Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course – 7

4 Credits **: 100 Marks**

1. Influence of PH on salivary amylase activity.
2. Quantitative estimation of of carbohydrates, proteins and fats from edible fish/poultry tissue.
3. Measures of Blood pressure
4. Estimation of serum, bilirubin (Direct and Indirect methods).
5. Oral glucose tolerance test.
6. Physiology experiments based on computer simulations.
7. Demonstration of endocrine glands in edible teleost/Crab
8. Effect of eye-stalk ablation on oxygen consumption in edible crab/prawn
9. Effect of Hormonal injections on coloration in edible fish.
10. Preparation of pituitary gland extract and injection to fishes to study the coloration and locomotory behavior in a teleost.
11. Packing and sterilization of glass and plastic wares for cell culture
12. Preparation of reagents and media for cell culture.
13. Primary culture of chicken embryo fibroblast.
14. Secondary culture of chicken embryo fibroblast.
15. Cultivation of continuous cell lines.
16. Isolation of lymphocytes and cultivation of lymphocytes
17. Cell viability assay.
18. Micronucleus test.
19. Haemolytic test for *Stephyllococcus aureus.*
20. CAM assay.
21. Total haemocyte count from haemolymph of crab.
22. Study of effect of toxic chemicals on cultured mammalian cells
23. Determination of water quality parameters (DO, CO2, acidity and alkalinity, Carbonates and bicarbonates, Phosphates in water samples.
24. Estimation of productivity of a pond ecosystem.
25. Determination of $LC_{50}/LD_{50.}$
26. Estimation/Detection of Pesticide residues in animal body tissues.
27. Identification of histopathological lesions by microscopy and Microtomy.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
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QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-1

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Estimation. 15 Marks

Q. 2. Blood Group/Clotting time. 15 Marks

Q. 3. Chromatography 10 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-II

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Osmotic Stress on Cell Membrane/RBC Count. 15 Marks

Q. 2. Estimation of RNA/DNA . 15 Marks

Q. 3. Spotting- Cell Division, Caryotype, Developmental stages Chick 10 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-III

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Specimen Study (Invertebrates, Vertebrates) . 20 Marks

Q. 2. Specimen study Evolution, Comparative anatomy, Equipments for animal Collection. 15 Marks

Q. 3.Parmanant Mount preparation of Fish Scale/Insect Trachea/ Naeris Parapodia. 05 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-IV

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Behavior study simulation experiment 10 Marks.

Q. 2. Gram Staining of Bacteria. 10 Marks

Q. 3. Spotting 20 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-V

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Experiment on rDNA. 15 Marks.

Q. 2. Biostatistics Problem. 15 Marks

Q. 3. Bioinformatics 10 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-VI

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Estimation Fecundity/Ova diameter study in fish. 10 Marks.

Q. 2. Spotting. 20 Marks

Q. 3. Morphometric meristics study in fish 10 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
QUESTION PAPER
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Lab Course-VII

Internal/External Examination Summer- _____

Marks - 50 Marks **Date:** **Time:**

Q. 1. Animal Biotech. 15 Marks

Q.2. Animal Physiology Simulation Experiment. 15 Marks.

Q. 3. Water Parameter estimation 10 Marks

Q. 4. Record Book 05 Marks

Q. 5. Viva 05 Marks

Examiners: 1. ---------- Signature

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2. ---------- Signature

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Practical Paper-ZOD-8
Title of the Paper- Dissertation/Review Writing

Marks-100 **Assessment Sheet** **Date:**

Sr. No.	Exam. Seat Number	Objective of Research Problem and its Scope	Research Done	Conclusion drawn	Presentation	Total marks
Marks		10	60	20	10	100
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1. Signature of External Examiner----------
   Name, Address of the Examiner----------

2. Signature of Internal Examiner----------
   Name, Address of the Examiner----------

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,
SCHOOL OF LIFE SCIENCES,
M. Sc. Zoology First Year
(Choice Based Credit System)
(Year 2017 Onwards)
Practical Paper-ZOD-8
Title of the Paper- Dissertation/Review Writing

Marks-100 **Final Assessment Sheet** **Date:**

Sr. No.	Exam. Seat Number	Total Marks by Internal Examiner	Total Marks by External Examiner	Average of Marks	Total Marks Obtained	Remarks any
Maximum Marks		50	50	100	100	
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1. Signature of External Examiner----------
   Name, Address of the Examiner----------

2. Signature of Internal Examiner----------
   Name, Address of the Examiner----------