

M. Sc. SYLLABUS

ZOOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

(Revised w.e.f. JUNE – 2016)



**BHAKTA KAVI NARSINH MEHTA
UNIVERSITY
JUNAGADH**

DEPARTMENT OF BIOSCIENCES

The UGC-CAS Department of Biosciences was established in 1969 by Late Prof. S.C. Pandeya as the founder Head of the Department. On the recommendations of the University Grants Commission, an integrated Post – Graduate Course in Biology was started as first of its kind in the Country. Later on, keeping Integrated Biology as the theme for the first year of the course, the academic programme was diversified into Plant Sciences, Animal Sciences and Microbiology, which were more recently renamed as M.Sc. in Botany, Zoology and Microbiology from the academic session 2007. From the academic session 2004-05, another M. Sc. Programme in Biotechnology was started. The Department initially started with its base in Environmental Sciences and in few years it took leadership in the field of ecology. Gradually, other areas of research, such as; Plant Physiology, Animal Physiology & Toxicology, Marine Biology & Coastal Ecology, Neurobiology, Ornithology, Wildlife Biology, Fisheries Biology, Insect Biology, Microbiology and Molecular Biology were also integrated into the thrust areas.

1. THE COURSE

The M.Sc. Course in Zoology is a full time curriculum, run for 2 years, spread over 4 semesters, with four theory Papers (three core and one interdisciplinary / multidisciplinary) and one combined practical in first two semesters. The last two semesters offer choice of courses to the students where two core courses and one elective (to be chosen from three available) courses will be taught. Any elective course will be taught only when prerequisite number of the student enrolls for that course. The minimum required number of student to run a course varies from course to course and to be decided by the Staff Council of the Department from time to time. A semester will be of about 90 working days. At the starting of Semester-III, students will be offered a Dissertation which is an original piece of research work and is partfulfilment for the degree, to be carried out by the student and submitted at the end of the fourth semester for evaluation. The elective courses and subject of dissertation should be decided by the student at the beginning of the 3rd Semester.

1.1 EDUCATIONAL STUDY TOUR

The Educational study tour (s) is **compulsory** and **part of the Curriculum to study different ecosystems, botanical, zoological and microbiological places of interest anywhere in the country.** Since the tour or tours are part of the curriculum, these can be conducted during any or all of the four semesters. The study tours can be undertaken anywhere within India to meet the academic demand. The students shall make Tour Reports and submit them during the IV Semester Examination for their evaluation. However, in special cases, alternative of the educational tour will be decided and assigned to the student concerned, by the Staff Council of the Department.

1.2 SEMINARS

Regular seminars will be organised on I and II Semesters and it is compulsory. Presentation on relevant topics, mostly from syllabus (oral and / or poster), is mandatory for the enrolled student. For each seminar, a student will be given marks, which will be added in the III Semester marksheet.

1.3 ATTENDANCE

Admitted students have to attend all the Lectures, Practicals and Seminars. A minimum prescribed attendance as per University rules is required to sanction a term grant. Students whose term is not granted will not be allowed to appear in the examination, and will have to join the same semester in the following year.

1.4. EXAMINATIONS

At the theory examinations, there shall be questions from the four units and all the questions are compulsory. Theory Examinations will be held at the end of each semester. However, Internal Examinations will be conducted by the Department during the ongoing Semester dates of which will be decided by the Staff Council. Students are required to apply in the prescribed application form for appearing in the Semester- end Theory Examination along with the necessary examination fees on the date to be notified by the University. The semester wise distribution of the courses and papers are given below.

2. SEMESTERWISE DISTRIBUTION OF MARKS:

SEMESTER-I:

4 Papers (100 Marks each*)	: 400	
1 Combined Practical	: 200	600

SEMESTER-II:

4 Papers (100 Marks each*)	: 400	
1 Combined Practical	: 200	600

SEMESTER-III:

3 Papers (100 Marks each*)	: 300	
1 Combined Practical	: 150	500
Seminars	: 50	

SEMESTER-IV:

3 Papers (100 Marks each*)	: 300	
1 Combined Practical	: 150	450
Tour / Field Work	: 50	
M.Sc. Dissertation (Thesis:150& Viva 50)	: 200	250

Grand Total	:	2400
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* 70 Theory + 30 Internal

2.1. EVALUATION OF PAPERS

The theory papers will be having a weightage of 100 marks each. Out of 100 marks, 30 marks are in the form of Internal Examinations. The written Semester end examination for a paper will be of 70 marks from 4 units. The question paper will be of 70 Marks. The question papers will be of 5 questions. However, these are subjected to changes as per University rules prevailing at that time.

3.0 ADMISSION

Academic year of the University begins from June. The lectures and practicals of the third semester starts immediately. The same for the first semester usually commences immediately after admissions. The admission process is as per the criteria laid down by the University, through written admission test and personal interview.

3.1 Eligibility:

The candidate with B.Sc. degree in Zoology with at least II class is eligible for admission to M.Sc. Zoology course. Students, who have cleared B.Sc. with Zoology as the second subject in S.Y. B.Sc. will also be considered for admission, provided the seats are available. A total of 20 seats are available in the Zoology stream out of which 10 seats are on Self-Financed basis. Students will be admitted as per the reservation policy in effect from time to time, as directed by the University.

The M.Sc. courses run by this Department are full time studies and as such, a student admitted to the Department cannot join any other courses or study, or take up any paid service.

Limited number of seats in the University Hostel is available to the students admitted to the Department. Desirous students will have to apply in prescribed form available from the Rector of the Hostels. Some scholarships and free-ships are awarded to the students as per the University Rules.

Last date for receiving the application forms and the date and time of Admission Interview are shown in the application form. **THE CANDIDATE SHOULD BRING ALL ORIGINAL MARK SHEETS, CERTIFICATES ETC. AT THE TIME OF THE INTERVIEW.**

3.2 Fee Schedules :As per University rules as applicable from time to time in both Grant-in-Aid and Self-Finance Schemes

3.3 Registration : Students admitted to the first semester in each of the streams will have to get registration as post-graduate students of this University. No transfer will be given to any student once registered for a particular stream.



Bhakta Kavi Narsinh Mehta University
Department of Life Sciences
Semester wise Paper Style of Master of Science (M.Sc.)
For C.B.C.S. Examination for all Semesters

Q 1. Answer the following : 14
(Any Seven out of Ten questions from whole syllabus – 02 marks each)

Q 2. Answer the following : 14
(Any Two out of Three questions – 07 marks each for two questions)

Q 3. Answer the following : 14
a) Write a note on (5 marks)
b) Write a note on (5 marks)
c) Answer specifically (4 marks)

OR

Q 3. Answer the following :
(a,b compulsory questions – 07 marks each for two questions)

Q 4. Answer the following : 14
d) Any two out of three questions (5 marks each)
e) Any one out of two questions (4 marks)

Q 5. Answer the following : 14
(Any Two out of four – 07 marks each for two questions)

Note :

Q.1 From all units

Q.2/Q.3/Q.4/Q.5 From Unit 1, 2, 3 and 4 in any order but a single question must cover a single unit.

M.SC. ZOOLOGY SYLLABUS
CHOICE BASED CREDIT SYSTEM (CBCS)
 (Total 96 Credits)

Course Code	Course Name	Hours /Week	Credits
SEMESTER - I			
Zool - 101	Cell Biology (Core)	04	04
Zool - 102	Molecular Biology, Genetics & Evolution (Core)	04	04
Zool - 103	Biodiversity & Biosystematics (Core)	04	04
Zool-104	Biostatistics and Bioinformatics** (Multi/ Inter disciplinary)	04	04
Zool-105	Combined Practical Course	14	08
Zool-106	Seminar Course-1*	02	00
	TOTAL		24
SEMESTER - II			
Zool - 207	Biochemistry (Core)	04	04
Zool - 208	Biotechnology & Immunology (Core)	04	04
Zool - 209	Environmental Science (Core)	04	04
Zool-210	Analytical Techniques** (Multidisciplinary / Interdisciplinary)	04	04
Zool-211	Combined Practical Course	14	08
Zool- 212	Seminar Course- 2*	02	00
	TOTAL		24
SEMESTER - III			
Zool - 313	Structure & Functions of Invertebrates (Core)	04	04
Zool - 314	Mammalian Physiology (Core)	04	04
	Elective Course** (any one of the following)	04	04
Zool - 315	Human Parasitology (Elective)		
Zool - 316	Developmental Biology & Adaptation (Elective)		
Zool - 317	Animal Ecology (Elective)		
Zool-318	Combined Practical Course	08	04
Zool - 425	Dissertation / Project Course: Part-1*	09	00
Zool-106+212	Seminar Course (1 + 2)*	00	02
	TOTAL		18
SEMESTER - IV			
Zool - 419	Aquaculture & Fisheries Technology(Core)	04	04
Zool - 420	Neurobiology (Core)	04	04
	Elective Course** (any one of the following)	04	04
Zool - 421	Marine Ecology (Elective)		
Zool - 422	Wildlife Biology & Animal Behaviour (Elective)		
Zool - 423	Endocrinology and Reproductive Physiology (Elective)		
Zool - 424	Combined Practical Course	08	04
Zool - 425	Dissertation / Project Course*	09	12
Zool - 426	Educational Tour / Field Work Course*	00	02
	TOTAL	00	30
	GRAND TOTAL	144	96

* (a) **Dissertation / Project** commences in III Semester but evaluated and Grade Points are to be added in 4th Semester. (b) **Educational Tours / Field Works** may be carried out in any Semester or all Semesters, but evaluated and Grade Points are to be added in the 4th Semester only. (c) **Seminar / Tutorial Courses** may be carried out in first two Semesters but evaluated and Grade Points are to be added in the 3rd Semester only.

DISSERTATION (Elective): Any one subject is to be chosen from the following (Subjects offered may change from time to time depending on the availability of expertise): Ecology, Wildlife Biology, Behavioural Ecology, Biodiversity, Marine Biology, Marine Biodiversity, Coastal Ecology, Eco-Toxicology, Physiology, Muscle Stem Cell Growth & Development, Insect Biology, Aracnology, Ornithology, Avian Biology, Taxonomy.

** Elective and Multidisciplinary / Interdisciplinary Courses may or may not have practical and/or field work.

DETAILED SYLLABUS

M. Sc. ZOOLOGY: SEMESTER - I

ZOOL. 101: CELL BIOLOGY

Unit-1 : Cell Structure & Cell Cycle

- 1.1 Cell Concept, Ultrastructure of Plasma Membrane, microbial and Plant Cell Wall.
- 1.2 Ultrastructure of Nucleus and Nucleolus. Pore Complex of Nuclear envelop.
- 1.3 Ultrastructure of Chromosome, Chromosomal Models, Special types of chromosomes.
- 1.4 Cell Cycle, G₁/S Transition, Cyclines and cyclin dependent kinases. Regulation of CDK - cycline activity.

Unit-2 : Cellular Organization

- 2.1 Mitochondria: Membrane Organization, Biogenesis and role in cellular energetics.
- 2.2 Chloroplasts: Ultrastructure, biogenesis, Photosynthetic units and reaction centres.
- 2.3 Ultrastructure and functions of Lysosome, Peroxisomes & Glyoxisomes.
- 2.4 GERL System and its functions. Vacuoles and their role in cell structure and function.

Unit-3 : Cytoskeleton, Cellular Transport & Sorting

- 3.1 Cytoskeleton: Ultrastructure and functions of Microtubules, microfillaments and associated proteins.
- 3.2 Cytoskeleton: Ultrastructure and functions of Actin, Myosin, IF and associated proteins.
- 3.3 Intracellular Junctions and their functions. Ca⁺⁺ dependent homophillic and non-homophillic cell-cell adhesion.
- 3.4 Transport across cell membrane: diffusion, active transport and pumps, uniports, symports and antiports.

Unit-4 : Cellular Communication, Apoptosis and Cancer

- 4.1 Cell surface receptors and their mode of action. Phenomenon of exocytosis and endocytosis
- 4.2 Second messenger system, MDP kinase pathways
- 4.3 Apoptosis: Mechanism and significance
- 4.4 Cell biological approach of cancer, AIDS

ZOOL. 102: MOLECULAR BIOLOGY, GENETICS & EVOLUTION

Unit-1. Population Genetics

- 1.1 Principles of Mendalian genetics
- 1.2 Hardy-Weinberg genetic equilibrium, Natural selection
- 1.3 Genetics of Speciation
- 1.4 Origin of life: Coacervates, Miller's experiment, theories of organic evolution

Unit-2. DNA as a hereditary material

- 2.1 Structure of Nucleic acids, Structural differences in prokaryotic and eukaryotic DNA
- 2.2 DNA constancy and C-value paradox,
- 2.3 DNA replication and DNA methylation
- 2.4 Linkage and genetic (chromosome) mapping

Unit-3. Gene structure and function (Prokaryotic and Eukaryotic)

- 3.1 Loci, alleles, and Gene structure
- 3.2 Genetic code
- 3.3 Transcription
- 3.4 Translation

Unit-4. Structural Changes in DNA material and Extra Chromosomal inheritance

- 4.1 Molecular basis of spontaneous and induced mutations,
- 4.2 Chromosomal aberration
- 4.3 DNA damage and repair
- 4.4 Extra-chromosomal inheritance

ZOOL. 103: BIODIVERSITY & BIOSYSTEMATICS

Unit – 1: Biodiversity

- 1.1 Basic Concepts of Biodiversity: Genetic, species and ecological diversity.

- 1.2 Terrestrial, Marine Biodiversity, Eco-tourism and Biodiversity. Conservation and Sustainable use of Biodiversity. Ecosystem monitoring and Rehabilitation.
- 1.3 Threats to Biological Diversity: Habitat Destruction, Invasive species, Disease, Over-exploitation, Pollution, Climate change and Biodiversity.
- 1.4 Structure and functions of the Convention on Biological Diversity (CBD), CBD mechanisms and working bodies. National Action Plan.

Unit – 2: Microbial Taxonomy

- 2.1 Principles of systematics and classification of microbes.
- 2.2 Introduction to akaryotes, virus, archaea & bacteria, cyanobacteria and prokaryotes
- 2.3 Fungus like protists: Cellular slime moulds, plasmodial slime moulds. General features of Fungus
- 2.4 Classification of Zygomycetes, Ascomycetes, Basidiomycetes, Mycorrhiza

Unit – 3: Plant Taxonomy

- 3.1 Principles of systematics and classification of Plants.
- 3.2 General features and Classification of green protists like diatom, dinoflagellates, lichens and algae
- 3.3 Non-tracheophytes (Mosses) and Non-Seed Tracheophytes (Ferns and Fern allies).
- 3.4 Seed plants: Gymnosperm and Angiosperms

Unit – 4: Animal Taxonomy

- 4.1 Principles of systematics and classification of Animals.
- 4.2 Classification of Protista (Flagellates, Amoebas, Ciliates and Apicomplexans).
- 4.3 Major invertebrate phyla, Lower chordates
- 4.4 Vertebrates: Fish, Amphibia, Reptiles, Birds and Mammals

ZOOL. 104: BIOSTATISTICS AND BIOINFORMATICS

Unit – 1: Basics and concepts of Biostatistics

- 1.1 Data, Tabulation, Classification, Frequency distribution and Graphics
- 1.2 Measure of Central Tendency – Mean, Mode & Median: Definition, Objectives, Merits, Demerits & Uses
- 1.3 Measure of Dispersion – Range, Variance, Standard deviation, Coefficient of Variation
- 1.4 Confidence limit and confidence interval

Unit – 2: Statistical tests in Biology

- 2.1 Student's t-test: Paired and Unpaired
- 2.2 Analysis of Variance
- 2.3 Regression and Correlation analysis
- 2.4 Chi-square test

Unit – 3: Basics of Bioinformatics and Biological Database

- 3.1 Introduction of Bioinformatics (Biological and IT links), Basic terminology
- 3.2 Application of bioinformatics in various fields: Medicine, Agriculture, Industries etc.
- 3.3 Types of biological database, File formats and Structure of database
- 3.4 Primary and Secondary database

Unit – 4: Sequence alignment, Gene prediction and Basic concepts of Omics

- 4.1 Sequence alignment: Nucleotide and Protein sequences, Pairwise and multiple sequence alignment, Phylogenetic relationship and importance of the study
- 4.2 Gene prediction: Gene structure in prokaryotic and eukaryotic systems, Prediction tools for the gene
- 4.3 Genomics: Definition and importance of the study
- 4.4 Other Omics (Transcriptomics, Proteomics and Metabolomics: Definition and importance of the study)

ZOOL. 105: COMBINED PRACTICAL COURSE

101. Cell Biology

1. Preparation of paraffin blocks of animal tissue – Understanding the cytological and histological techniques
2. Section cutting, spreading and staining methods, Microscopy
3. Supra – vital Cytological staining of cellular organelles
4. Cellular metabolites: Permanent Cytological Staining
5. Nucleic Acids: Permanent Cytological Staining
6. Cytogenetics: Onion root tip squash preparation for mitosis

7. Dipteran salivary gland squash preparation for giant chromosome
8. Cytological Staining of Barr body
9. Cytogenetics: Stages of meiosis
10. Histological and Cytological Staining of Drumstick
11. Enzyme histochemistry & Cytochemistry
12. Observations on permanent cytological slides

102. Molecular Biology, Genetics & Evolution

1. To confirm thalassemia by NESTROFT (Necked Eye Single Tube RBCs Osmotic Fragility Test)
2. To induce polyploidy in root of *Allium cepa* and observe cytological changes in cell
3. To study karyotype of human chromosome
4. Identification of normal male and female karyotype
5. Identification of Turner syndrome using Karyotype
6. Identification of Klinefelter syndrome using the karyotype
7. Identification of Down syndrome using the karyotype
8. Identification of Edwards syndrome using the karyotype
9. To perform linkage analysis and Map construction with example
10. To perform Pedigree analysis and Probabilities with example
11. Staining of Microbial Cells: Monochrome, Negative & Gram Staining
12. Bacterial Motility (Hanging Drop Method)
13. Bacteriological Media Composition & Preparation and Bacterial Cultivation Methods

103. Biodiversity & Biosystematics

1. General features & classification of Invertebrates up to class or order
2. General features & classification of vertebrates up to class or order
3. General features and classification of diatoms, dinoflagellates, lichens and algae
4. General features and classification of non-tracheophytes and non-seed tracheophytes
5. General features and classification of Gymnosperms
6. General features and classification of angiosperms
7. Negative staining, Differential staining (Gram's staining)
8. Specialized staining: Capsule staining, Spirocheck staining, Metachromatic granule staining, Cell wall staining
9. Hanging drop techniques for motility

104. Biostatistics & Bioinformatics

Biostatistics:

1. Frequency Distribution
2. Standard Deviation and Coefficient of Variation
3. Confidence limits for the population mean
4. Students 't' test
5. Analysis of Variance
6. Regression and Correlation
7. Chi Square Test

Bioinformatics :

8. Basic Terminologies in Bioinformatics
9. Biological databases
10. NCBI Search for Gene Sequences
11. UniProt Knowledgebase (UniProt KB) Search for Protein Sequences
12. RCSB PDB search for Protein 3D Structures
13. Pair wise Sequence Alignment using NCBI BLAST
14. Pair wise Sequence Alignment using Bio edit
15. Multiple Sequence alignment using CLC Protein Workbench
16. Multiple Sequence alignment using Clustal X
17. Analysis of 3 D structure of protein by Rasmol

M.Sc. ZOOLOGY : SEMESTER - II

ZOOL. 207: BIOCHEMISTRY

Unit – 1 : Carbohydrates, Lipids and Fatty Acid metabolism

- 1.1 Monosaccharides and disaccharides: Types and properties
- 1.2 Polysaccharides: Homopolysaccharides and heteropolysaccharides
- 1.3 Classification and properties of simple and compound lipids
- 1.4 Function of lipids, Metabolism of fatty acids: Beta oxidation

Unit – 2 : Protein Structure and Function

- 2.1 Properties of amino acid, titration curves and function of proteins
- 2.2 Primary and Secondary structure of protein
- 2.3 Tertiary structure of protein, Ramchandran Plots
- 2.4 Quaternary structure of protein: globular and fibrous

Unit – 3 : Enzymes: Basic Concepts and Kinetics

- 3.1 An introduction to enzymes: Nomenclature and classification
- 3.2 Principles and mechanism of enzymes catalysis: single and multisubstrate, Coenzymes and cofactors
- 3.3 Kinetic properties of enzymes, Michaelis-Menten Model, Double reciprocal plot
- 3.4 Enzyme Inhibition: Competitive, Non- competitive, Uncompetitive and Mixed type

Unit – 4 : Metabolism: Basic Concepts and Regulation

- 4.1 Concept of Bioenergetics: laws of thermodynamic, Entropy and Enthalpy, Energy rich compounds and electron carriers
- 4.2 Glycolysis and Citric Acid Cycle
- 4.3 Other pathways of carbohydrate metabolism ED, Pentose Phosphate, Glyoxylate, Gluconeogenesis
- 4.4 Allosteric proteins, Feedback inhibition

ZOOL. 208: BIOTECHNOLOGY & IMMUNOLOGY

Unit – 1 : Biotechnology -1.

- 1.1 Bioremediation: Principles and Methods,
- 1.2 Techniques of immobilization of enzymes & cells
- 1.3 Applications of Immobilized Enzymes & Cells
- 1.4 Principles and techniques of animal tissue culture

Unit – 2 : Biotechnology -2

- 2.1 Basics of genetic engineering
- 2.2 DNA isolation techniques
- 2.3 Restriction enzymes, Gene targeting
- 2.4 Vectors : plasmids, cosmids and phages, Host vector system, Screening of the recombinant clones

Unit – 3 : Plant Tissue culture

- 3.1 Principles and Techniques of Plant Tissue Culture
- 3.2 Basic Steps of Plant Tissue Culture
- 3.3 Selection of Plant Culture Media
- 3.4 Types of Plant Tissue Cultures

Unit – 4 : Immunology

- 5.1 Antigen Antibody: Structure of Ig, Ig Classes & Biological Activities, Factors Influencing Immunogenicity, Monoclonal Antibodies
- 5.2 Innate and Adaptive Immune System
- 5.3 Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence
- 5.4 Delayed and Immediate Hypersensitive Reactions, Autoimmunity

ZOOL. 209: ENVIRONMENTAL SCIENCE

Unit-1 Environment

- 1.1 Definition, principles and Scope of Environmental science.
- 1.2 Earth, Man and Environment, Ecosystems, Pathways in Ecosystems, Physico-chemical and Biological

factors in the Environment, Geographical classification and zones.

- 1.3 Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
- 1.4 Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind.
- 1.5 Atmospheric stability, inversions and mixing heights, wind roses

Unit-2 Ecosystem

- 2.1 Definition, Principles and scope of ecology, Human ecology and human settlement,
- 2.2 **Ecosystems:** Structure and functions, abiotic and Biotic components, food chains, food web, ecological pyramids, population, community ecology and parasitism, prey-predator relationships
- 2.3 Biomes of the world
- 2.4 Overview of Sanctuaries, National park and Botanical garden

Unit-3 Pollution

- 4.1 Air: Natural and anthropogenic sources of pollution, primary and secondary pollutants, Transport and diffusion of pollutants. Gas laws governing the behavior of pollutants in the atmosphere. Methods of monitoring and control of air pollution SO₂, NO_x, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate, Acid rain, Air Quality Standards
- 4.2 Water: Types, Sources and consequences of water pollution, physico-chemical and bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard
- 4.3 Soil: Physico-chemical and bacteriological sampling as analysis of soil quality, Soil pollution control, Industrial waste effluents and heavy metals, their interactions with soil components. Degradation of different insecticides, fungicides and weedicides in soil. Soil organic and inorganic components
- 4.4 Global Environmental problems: Ozone depletion, global warming and climatic change, clean development mechanism.

Unit-4 Environmental Impact Assessment

- 3.1 Introduction to environment impact analysis, Environmental impact statement and environmental management plan, Impact Assessment methodologies
- 3.2 Generalized approach to impact analysis
- 3.3 Procedure for reviewing environmental impact analysis and statement
- 3.4 Principles of Remote sensing and its applications of environmental sciences, Application of GIS in Environmental management

ZOOL. 210: ANALYTICAL TECHNIQUES

Unit – 1 : Microscopy and Autoradiography

- 1.1 Theories of Tissue fixation and staining techniques
- 1.2 Principles of Transmission and Scanning Electron microscopy
- 1.3 Principles of Phase Contrast and Fluorescence Microscopy
- 1.4 Principle and applications of Autoradiography

Unit – 2 : Spectroscopy

- 2.1 Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD
- 2.2 CD and structure of proteins using NMR and ESR
- 2.3 Neutron and X-Ray diffraction for elucidation of 3D structure
- 2.4 Molecular modelling, Mass Spectrometry

Unit – 3 : Chromatographic techniques

- 3.1 Basic Principle and types of Chromatography
- 3.2 Gas Chromatography, GC-MS, LC – MS / MS
- 3.3 Ion Exchange Chromatography, gel permeation, Affinity and reverse phase chromatography
- 3.4 HPLC and FPLC

Unit – 4 : Centrifugation and Electrophoretic Techniques

- 1.1 Principle and applications of Centrifugation techniques
- 1.2 Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
- 1.3 Isoelectric focusing, 2D-PAGE and their uses in protein research
- 1.4 Fractionation and Blotting Techniques

ZOOL. – 211 : COMBINED PRACTICAL COURSE**207. Biochemistry: Suggested Laboratory Work**

1. To prepare a titration curve of a weak acid with a strong base
2. To prepare a titration curve and determine the pK and pI value of an amino acid
3. Qualitative analysis of Carbohydrates
4. To prepare a calibration curve of reducing sugars by DNSA
5. Extraction and estimation of reducing and non-reducing sugars by DNSA method.
6. To prepare a calibration curve of protein by Folin-Lowry method
7. Extraction and estimation of protein by Folin-Lowry method
8. To prepare a calibration curve of amino acid using Ninhydrin reaction method
9. Extraction and estimation of free amino acid content in germinating seeds by ninhydrin reaction method
10. To prepare a calibration curve for para nitrophenol
11. Estimation of enzyme acid phosphatase activity from given plant material
12. Determination of Vmax and Km
13. To separate amino acids by ascending paper chromatography
14. To determine acid value of fats and oils
15. To determine saponification value of fats and oils
16. Protein purification Table

208. Biotechnology: Suggested Laboratory Work

1. Isolation & Identification of Bacteria, Yeasts & Fungi
2. Biochemical Tests: Metabolic Activities of Enteric Bacteria: Sugar Fermentation, IMViC, H₂S production, Phenylalanine Deaminase, Urea Hydrolysis, Nitrate Reduction, Amylase, Protease
3. Detection of Extracellular Alkaline Protease, amylase from Haloalkaliphilic Actinomycetes
4. Determination of Alkaline Protease from Haloalkaliphilic Actinomycetes using Anson-Hagihara's Method
5. Concept of Totipotency
6. Direct ELISA Technique
7. Indirect ELISA Technique
8. Antigen preparation
9. Preparation of plant tissue culture media
10. Callus culture from leaf material
11. To perform the Ouchterlony double diffusion.
12. To learn the technique of Immunoelectrophoresis
13. To learn the technique of radial immunodiffusion.
14. To learn the technique of agglutination.
15. To perform sandwich DOT ELISA test for antigen.
16. To perform Rocket Immunoelectrophoresis
17. To perform Western Blot Technique
18. To isolate genomic DNA from bacterial isolate

209. Environmental Science: Suggested Laboratory Work

1. To determine color of soil by physical observation and to determine water holding capacity
2. To determine field capacity of soil
3. To determine temperature soil by thermometer.
4. To determine soil-moisture by oven drying
5. To determine soil texture
6. To estimate the amount of organic carbon by Walkley and Black titration method
7. To estimate total nitrogen from given soil
8. To estimate the amount of Ca from given soil sample
9. To estimate the amount of Mg from given soil sample
10. To determine the amount of carbonate in the soil by rapid test
11. To determine the amount of nitrate by rapid test
12. To determine the base deficiency of soil by rapid test
13. To determine reductivity of soil by rapid test
14. To determine the amount of organic carbon by Walkley's and Black's titration method
15. To determine the amount of chloride by rapid test
16. To determine Calcium Carbonate in the Soil.
17. To determine phosphate content in the soil

18. To study the meteorological apparatus
19. To determine the alkalinity of given water sample.
20. To determine acidity of given water sample.
21. Dissolved oxygen (DO)
22. Biological oxygen demand (BOD)
23. Chemical oxygen demand (COD)
24. Bacteriological analysis by MNP
25. Color, turbidity, odour and pH, TS, TDS and TSS
26. Chloride estimation
27. Sulfate estimation
28. Ca-Mg Hardness/ Estimation of total hardness of water by EDTA method.
29. Phosphorus Phosphate estimation(ascorbic acid method)
30. Estimation of Nitrite-Nitrogen of given water sample

210. Analytical Technique: Suggested Laboratory Work

1. Demonstration of a state-of-the-art compound microscope with Brightfield, Phase-Contrast, Fluorescence and Darkfield operational details.
2. Demonstration of computer controlled brightfield microscopy
3. Demonstration of Image capturing and Image analysis by Image Analysis software
4. Determination of various image analysis parameters (cell or tissue length, width, diameter etc.) by using both microscopy and image capturing and analyses.
5. Demonstration of Stereo zoom dissecting microscope
6. Determination of various image analysis parameters (Tissue or Organism length, width, diameter etc.) by using both microscopy and image capturing and analyses.
7. Localization of anthocyanin in plant tissue
8. Localization of phenols in plant tissue
9. Localization of Tannins in plant tissue
10. Localization of alkaloids in plant tissue
11. Localization of lignins in plant tissue
12. Localization of starch in plant tissue
13. Localization of flavanoids in plant tissue
14. Determination of molecular mass of Protein by size exclusion chromatography (Theoretical)
15. PCR amplification of gene
16. DNA sequencing of the amplified gene
17. Electrophoresis of PCR product

M.Sc. ZOOLOGY :SEMESTER - III

Zool. – 313: STRUCTURE & FUNCTIONS OF INVERTEBRATES(CORE)

Unit -1.

- 1.1 Taxonomic procedures, animal collection, handling and preservation of Invertebrates.
- 1.2 Classification, organization and general characteristics of major invertebrate phyla.
- 1.3 Organization and general characteristics of minor phyla.
- 1.4 Organization and general characteristics of lower vertebrates.

Unit -2.

- 2.1 Strategies and evolutionary significance of larval forms.
- 2.2 Larval forms of free living invertebrates.
- 2.3 Larval forms of parasitic invertebrates.
- 2.4 Patterns of feeding and digestion in Invertebrates

Unit -3.

- 3.1 Locomotor organs and mode of locomotion in Invertebrates
- 3.2 Respiratory organs, pigments and mode of respiration in invertebrates
- 3.3 Excretion in Invertebrates
- 3.4 Reproduction in Invertebrates

Unit-4.

- 4.1 Agricultural pests and their pathogenicity
- 4.2 Pests of stored grains and their pathogenicity
- 4.3 Insect pest management: Chemical, environmental and biological control
- 4.4 Useful insects, general consideration and systematic. Silk, Lac and Honey

Zool - 314 :MAMMALIAN PHYSIOLOGY (CORE)

Unit -1.

- 1.1 Overview of mammalian digestive system. Physiological role of digestive juices.
- 1.2 Integumentary system. Skin glands and appendages.
- 1.3 Overview of mammalian reproductive system.
- 1.4 Ultrastructure and functions of mammalian Malpighian Corpuscles, proximal and distal convoluted tubules, Hennel's loop. Physiology of Urine formation.

Unit - 2.

- 2.1. Physiology of respiration: Detailed accounts of Ventilation, diffusion and Perfusion.
- 2.2. Cardio-vascular system. Structure and functions of special cardiac tissue, mechanism of heart beat.
- 2.3. O₂ transport.
- 2.4. CO₂ transport.

Unit - 3.

- 3.1. Ultrastructure of actin and myosin. Physiology and molecular basis of muscle contraction and the events therein.
- 3.2. Lymphatic System and its functions
- 3.3. Physiology of Thermoregulation
- 3.4. Osmoregulatory mechanisms in aquatic, terrestrial and desert animals.

Unit -4.

- 4.1. Sense of hearing - Ear: Organ of Corti and the physiology of hearing.
- 4.2. Sense of vision - Eye: Rod and Cone cells, biosynthesis of visual pigments and the photochemical reaction.
- 4.3. Sense of Smell : Ultrastructure of the Receptor cells, physiology of the sense of smell.
- 4.4. Sense of Taste : Ultrastructure of the Receptor cells, physiology of the sense of taste.

Zool – 315: HUMAN PARASITOLOGY(ELECTIVE)**Unit-1.**

- 1.1 Host – parasite relationship, importance of parasitic life cycle and infection
- 1.2 Classification of parasites and methods for diagnosis of parasitic disease
- 1.3 Protozoan and Amoebic parasites, lesions, diagnosis, pathogenesis, treatment & control
- 1.4 Classification, life cycle, pathogenesis, diagnosis, treatment and control of Flagellates and Haemoflagellates.

Unit-2

- 2.1 Plasmodiums: morphology, life cycle, immunity, pathogenesis, control and epidemiology
- 2.2 Life cycle and clinical feature of Apicomplexa, their importance in AIDS
- 2.3 Tape worms, their pathogenesis and control
- 2.4 Life cycle, pathogenicity, treatment and control of diseases caused by Trematodes.

Unit-3.

- 3.1 Nematodes, the diseases caused by them, their treatment and control
- 3.2 Tissue Nematodes, diseases caused by them, their treatment and control
- 3.3 Arthropods Vector and their classification, Mode of transmission and pathogenesis of diseases caused by Arthropod vectors
- 3.4 Control mechanisms of Arthropod vectors

Unit-4.

- 4.1 Opportunistic parasitic infections in people with HIV or AIDS
- 4.2 Sexually transmitted parasites
- 4.3 Parasitic infections in people with immunodeficiency, cancer and transplant recipients.
- 4.4 Diagnostic methods in parasitology

Zool – 316: DEVELOPMENTAL BIOLOGY & ADAPTATION (ELECTIVE)**Unit - 1.**

- 1.1. Process of spermatogenesis. Structure and functions of Leydig cell and its regulation. Semen composition and functions of semen, assessment of sperm functions.
- 1.2. Process of Oogenesis, ovulation, Production of corpus luteum and its functions
- 1.3. Fertilization. Pre-fertilization and post-fertilization events.
- 1.4. Role of maternal contribution in early development. Cleavage patterns & fate map, cell differentiation

Unit - 2.

- 2.1. Blastulation of frog and chick
- 2.2. Gastrulation of frog and chick
- 2.3. Early embryonic development
- 2.4. Extra embryonic membranes and placenta

Unit - 3.

- 3.1. Levels of adaptation. Mechanisms of adaptation. Acclimation and acclimatization.
- 3.2. Physiological adaptations to terrestrial environment.
- 3.3. Physiological adaptations to freshwater environment
- 3.4. Physiological adaptations to marine, shore and estuarine environment.

Unit - 4.

- 4.1. Physiological adaptations in extreme terrestrial environment.
- 4.2. Physiological adaptations in extreme aquatic environment.
- 4.3. Parasitic adaptations
- 4.4. Basic concept of environmental stress and strain, concept of elastic and plastic strain, stress resistant, avoidance and tolerance.

Zool. – 317 :ANIMAL ECOLOGY (ELECTIVE)

Unit – 1 : Population Ecology

- 1.1 Population, population dispersion, types.
- 1.2 Population dynamics, demography, factors affecting population growth rate.
- 1.3 Biotic potential, exponential and logistic growth models,
- 1.4. Population density, r-selected and k-selected species, measurements of population indices. realized and fundamental niche

Unit – 2 : Community Ecology

- 2.1 Community concept, structure, indices
- 2.2 Resource partitioning, predation and prey populations, parasitism.
- 2.3 Plant defence against herbivores, defence against predators, defensive colouration, mimicry, chemical defence.
- 2.4 Keystone species

Unit – 3: Marine & Coastal Ecology

- 3.1. The shore environment. Physico-chemical and biological factors of intertidal zone. Distribution of life on rocky shores, sandy shores and muddy shores.
- 3.2. Zonation and adaptation of organisms in the intertidal habitats.
- 3.3. Benthos: Distribution of shallow water benthic organisms. Distribution and adaptation of deep-sea benthic organisms. Marine animal associations: commensalisms symbiosis and parasitism.
- 3.4. Coral reef ecology: Special features of coral reef habitats and distribution of coral reef organisms. Mangrove systems: Special features of mangrove habitats and distribution of plants and animals in mangrove ecosystems.

Unit – 4 :Environmental Monitoring and Bio deterioration

- 4.1 Anthropogenic activity and Environment: Environmental monitoring methods.Toxicology: Classification of toxicants and xenobiotics including metals, pesticides, solvents and POPs. Lethal and sub lethal effects of pollutants, evaluation of toxicity tolerance, bioassay.
- 4.2 Role of biotechnology in environmental pollution control: Indicator organisms, Test organisms, Monitoring organisms, Enzymes.
- 4.3 Coastal developmental activities-environmental issues. Micro and Macro fouling, corrosion of metals and alloys in the sea, effects of bio-fouling and bio deterioration on marine structures.
- 4.4 Environmental Policy and Environmental Impact Assessment. Anti-corrosion and fouling application of biotechnology in controlling the bio deterioration of wood and synthetic substances in the sea. Red tides: Cause character and effects on the organisms of Marine environment

Zool. – 318 : COMBINED PRACTICAL COURSE

Z-313: Structure & Functions of Invertebrates

1. Systematic study of lower invertebrate through permanent slides (protozoa to porifera).
2. Systematic study of lower invertebrate through permanent slide (coelenterate to aschelminthes).
3. To study the mouth parts of some insects (Arthropoda) through permanent slide.
4. To study the methods of protozoan culture.
5. To study isolation and identification of various protozoa from given water sample.
6. Systematic study of phylum coelenterate through specimen.
7. Systematic study of phylum Platyhelminthes through specimen.
8. Demonstration of alimentary canal of *PheretimaPosthuma* (earthworm).
9. Demonstration of blood glands, ovary, nephridia, setae and testes of earthworm.
10. Demonstration of reproductive system of *PheretimaPosthuma*.
11. To study the systematic study of minor phyla.
12. To study the systematics of lower chordates through specimen.
13. Preparation of permanent mounting of a given material.

314. Mammalian Physiology

1. Anatomical and Physiological perspectives of mammalian circulatory system
2. Anatomical and Physiological perspectives of mammalian Urino-genital system
3. Anatomical and Physiological perspectives of mammalian Brain and cranial nervous system

4. Anatomical and Physiological perspectives of mammalian neck nerves
5. Physiological characteristics of skeletal muscle, pecten, medullated and non-medullated nerves
6. Tissue (block) preparation for the histological studies of mammalian tissues.
7. Permanent histological preparation of major tissues
8. Permanent histological preparation of few endocrine glands
9. Spotting of histological slides
10. Histochemical studies on Enzyme activity

315. Human Parasitology

1. Life cycle of different Human parasites
2. Characteristic features of different human parasites
3. Observations of histological / permanent preparation of various human parasites

316. Developmental Biology & Adaptation

1. Studies on the permanent slides of different stages of frog embryo.
2. Studies on the permanent slides of different stages of chick embryo.
3. Studies on the different stages of chick embryo. Permanent preparation of chick embryo
4. Chick embryo transplantation

317. Animal Ecology

1. Studies on the animals from different ecological habitats of the intertidal zones.
2. Studies on the adaptational characteristics of different ecological habitats.
3. Studies on the population indices (Density, Abundance, Frequency) of ecological habitats.
4. Studies on the community indices of ecological habitats.

M.Sc. ZOOLOGY :SEMESTER - IV

Zool. – 419: AQUACULTURE & FISHERIES TECHNOLOGY (CORE)

Unit – 1

- 1.1 Diversity of Fish, Systematics and Taxonomy: Origin of fish, Jawless fish, cartilaginous and bony fish.
- 1.2 Aquaculture and its importance: Advantages, scope and status of aquaculture in India and Gujarat. Aquaculture techniques and controlling factors.
- 1.3 Fishing vessels: Materials for manufacturing boats, parts of boats, types of boats both traditional and modern used in India as well as in Gujarat, their characteristics and advantages.
- 1.4 Fishing gears: structure and applications of gill net, hoop net, seine net, purse – seine net, drift net, trawl net and hook – line net.

Unit – 2

- 2.1 Fish Preservation: Need of preservation, common criteria for freshness, methods of preservation and their advantages.
- 2.2 Fish Processing: Methods used in industries, their advantages and applications.
- 2.3 Fish by-products: Common and industrial fish by-products and their uses.
- 2.4 Fish marketing and fisheries management: Production and Marketing strategies, over fishing problem, fisheries management, fishing community and other factors.

Unit-3

- 3.1 Freshwater capture and culture fisheries, status in India and Gujarat, fishing gears and main fishing centres.
- 3.2 Estuarine capture and culture fisheries. Status of Gujarat compared to National Status, fishing gears and main fishing centres, development of estuarine brackish water culture fishery.
- 3.3 Marine capture fisheries: Status of Gujarat in comparison to the National status. Pomfret fishery, Bombay duck fishery, Prawn fishery, deep – sea fishery, fishing gears, fishing season and main landing centres of Gujarat.
- 3.4 Marine capture fisheries: Lobster, crab, molluscan and Pearl Oyster fisheries of Gujarat State.

Unit-4

- 4.1 Accessory respiratory organs in fish: Need, detailed structure and respiratory functions of external gills, skin, lining of the gut, labyrinthine organ, sacculus, air bladder.

- 4.2 Colour changing in fish: Detailed morphological structure of chromatophore cells, their types and pigment content, physiology of colour change and controlling factors. Reproductive strategies of fish: Spawning migration, location of egg deposit, mode of fertilization and parental care.
- 4.3 Induced breeding: Fish breeding, hypophysectomy technique, factors controlling induced breeding, fish seed collection, transport and stocking.
- 4.4 Fish diseases and control: Common fungal, bacterial, protozoan and other diseases of fish, symptoms and control methods.

Zool. – 420: NEUROBIOLOGY(CORE)

Unit-1

- 1.1 Nervous system in Invertebrates, Evolution of brain.
- 1.2 Basic plan of nervous system in vertebrates
- 1.3 Morphology and functions of different parts of human brain
- 1.4 Histogenesis of nerve tissue. Classification, structure and functions of neurons, neuroglia.

Unit-2

- 2.1 Formation of myelin sheath, resting equilibrium, action potential and measurements.
- 2.2 Synapses and their classification, ultrastructure of synapse
- 2.3 Neurotransmitters, their classification and functions.
- 2.4 Glucose and energy metabolism in brain.

Unit-3

- 3.1 Neuropeptides and their functions.
- 3.2 Endorphins; opiate peptides, pain killers and their functions
- 3.3 Memory: STM, LTM, Physiology of memory.
- 3.4 Role of Central Nervous System in hypertension

Unit-4

- 4.1 Epilepsy and its control
- 4.2 Melatonin: chemical structure & functions.
- 4.3 Depressions and their control.
- 4.4 EEG, brain topography and its applications

Zool. – 421 :MARINE BIOLOGY (Elective)

Unit - 1: Physical and Chemical Oceanography

- 1.1 Physical oceanography: light, temperature, salinity, density and pressure distribution in the oceans. Currents: Relative currents, wind currents, upwelling and sinking.
- 1.2 Tides: tide-producing forces and tide characteristics. Circulation patterns and currents. Ocean-land-atmospheric interactions: Monsoons, cyclones, anticyclones
- 1.3 Chemical Oceanography: Salinity and chlorinity, pH and carbon dioxide systems in the sea water.
- 1.4 Distribution of nutrients and their cycles. Eutrophication. Dissolved and particulate organic matter in the sea: its chemical nature and properties.

Unit - 2: Biological Oceanography & Marine Living Resources

- 2.1 Introduction of plankton, nekton and benthos; general classification and composition of plankton; floating mechanism of plankton. Collection of plankton, instruments and nets employed, methods of fixation and preservation of plankton, Distribution of plankton in space and time.
- 2.2 Primary production: Survey of methods, factors affecting Primary production: Phytoplankton – zooplankton relationships.
- 2.3 Marine food chains (pelagic and benthic). Mass-mortality in sea: Red water phenomenon.
- 2.4 Marine Microbiology: Marine Bacteria: general account of their role in the economy of the sea.

Unit - 3: Estuaries and Coastal Zone management

- 3.1 Estuarine and coastal environment: classification and physico – chemical parameters of estuaries. Distribution of estuarine plankton, nekton and benthos. Estuarine birds, estuarine food web. Mangroves, sea-grasses, marine fungi.
- 3.2 Marine and coastal living resources and their management.
- 3.3 Coastal Zone Management: Impact of dredging, mining and pollution on coastal habitats and their management methods.

3.4. Remote sensing application in coastal zone management. Coastal zone regulations.

Unit - 4. Marine Pollution, Conservation and Tourism

- 4.1. Marine Pollution: Major sources of pollution. Sewage: Domestic, Industrial, agricultural and aquacultural discharges, their composition and fate in the marine environment, toxicity and treatment methods, sewage disposal system. Environmental Impact Assessment Methods of coastal activities.
- 4.2. Oil pollution: Sources and fate of oil, composition and toxicity of oil, biological effects treatment procedures. Enzymatic removal of hazardous organic substances from aqueous effluents.
- 4.3. Thermal and radioactive pollution: Source and characteristics, strategies for disposal of RNA and Heated effluents, biological effects and alternative uses of waste dumping, mining and dredging operations, their effects on the organisms and marine environment
- 4.4. Marine Tourism of India and Abroad, Famous Beaches of India, Eco-tourism and recreational tourism, marine Amusement parks and their impact on Tourism, various causes affected to Eco-tourism.

Zool. – 422 : WILDLIFE BIOLOGY & ANIMAL BEHAVIOUR (Elective)

Unit-1. Outline of Ecological sub-divisions of Indian Wildlife

- 1.1 Review and classification of Indian herpetofauna, birds and mammals
- 1.2 Himalayan Mountain Systems and Indian Deserts
- 1.3 Peninsular Indian sub-region and Tropical Evergreen Forests
- 1.4 Andaman - Nicobar Islands and Mangrove Forests (Sundarvan)

Unit-2. Conservation and Development

- 2.1 Causes of wildlife depletion and Legislation
- 2.2 Biosphere reserves and Zoos in India
- 2.3 Important National National Parks&Sancturaies of India
- 2.4 National Parks &Sanctuaries of Gujarat

Unit-3. Wildlife Management, Protection& Case Histories

- 3.1 Extensive and intensive management, instruments used for wildlife management
- 3.2 Identification of Damage&Control methods
- 3.3 Endangered species, Project Tiger, Gir Lion Sanctuary Project, Crocodile, Hangul and Musk Deer Projects.
- 3.4Wildlife and migratory route. International Trade in Endangered species

Unit-4 Animal Behaviour

- 4.1. Animal behaviour : Classification, instinct, imprinting, learning, foraging and feeding behaviour.
- 4.2. Sexual behaviour, social behaviour and parental care. Socio-biology of birds and mammals
- 4.3. Circadian rhythm, Kin selection concept, its importance in hymenoptera and altruism.
- 4.4. Adaptive radiation, zoogeographical realms and types of distribution. Migration of fish, birds and mammals

Zool – 423: ENDOCRINOLOGY & REPRODUCTIVE PHYSIOLOGY (Elective)

Unit - 1.

- 1.1. Local and endocrine hormones, their characteristics.
- 1.2. Mechanism of hormone action.
- 1.3. Characteristics of pituitary hormone secreting cells, neurohypophysis and its hormones.
- 1.4. Pituitary hormones and their functions and control.

Unit - 2.

- 2.1. Ultrastructure of Thyroid gland. Biosynthesis of thyroid hormones, control of thyroid hormone secretion, thyrocalcitonin, hypo and hyper thyroidism, goiter.
- 2.2. Ultrastructure of Parathyroid gland and its hormones.
- 2.3. Ultrastructure of endocrine Pancreas, its hormones and their functions.
- 2.4. Insulin and blood - glucose regulation.

Unit-3.

- 3.1. Ultrastructure of Adrenal glands, its hormones and their functions.
- 3.2. Renin - Angiotensin system and its role in blood pressure regulation.
- 3.3. Functions of kidney hormones.
- 3.4. Local hormones and their functions

Unit – 4.

- 4.1 Gonadal hormones and their functions. Physiology of sexual development.
- 4.2 Hormonal control of reproduction. Reproductive disorders.
- 4.3 Causes of Infertility in human, its control and management.
- 4.4 Contraceptive technologies. IVF and other assisted reproductive technologies.

Zool. – 424 : COMBINED PRACTICAL COURSE**419. Aquaculture & Fisheries Tech.**

1. Classification of fish
2. Studies on the various types of fishing gears.
3. Studies on various types of fishing vessels.
4. Studies on the organoleptic methods for freshness determinations of fish.
5. Anatomical consideration of the brachial system of fish.
6. Identification of unknown fish up to the genus level by using identification keys.
7. Length-weight relationship in prawns.
8. Gonado-Somatic Index and Fecundity Index of fish

Z-420: Neurobiology

1. To study the nervous system of *Pheretima Posthuma* (earthworm).
2. To study the nervous system of *Sepia* (cuttle fish).
3. To study the nervous system of *Aplysia* (sea hare).
4. Demonstration of brain slicer and slicing.
5. To study the electron micrograph of nerve cells and study of cell organelles.
6. To study various cell organelles and neuronal components of nerve cell and some diagrams.
7. Study of the indigenous device and some diagrams with reference to some nerve physiology.
8. To study about electroencephalogram.
9. To study about brain topography and its application.

421. Marine Biology

1. Determination of Dissolve Oxygen (DO) concentration of given water sample by Winkler's methods.
2. Determination of Biological Oxygen Demand (BOD) from given water sample by Winkler's methods.
3. Estimation of primary productivity.
4. Determination of Total Dissolve Solids (TDS).
5. Determination of chlorinity and salinity.
6. Determination of total alkalinity and conductivity.

422. Wildlife Biology & Animal Behaviour

1. Field Study: Bird Watching.
2. Field study: Behavioural activity of wild animals
3. To study the occurrence of activities
4. To study the scale pattern of given materials
5. Several tools and technique used for wildlife study
6. Advance research methods : 3S techniques
7. Dentition and dental formulae in mammals
8. To study tracks of animals and birds
9. Functional anatomy and biomechanism in animals
10. Behavioural ethogram in birds
11. Zoogeographical realms and types of distribution
12. Studies on Herps
13. Extensive and intensive managements for conservation
14. Habitat case studies

423. Endocrinology & Reproductive Physiology

1. Anatomical features of the male reproductive system of mice/rat.
2. Anatomical features of the female reproductive system of mice/rat.
3. Endocrine glands mice/rat.
4. Histological study of the permanent slides of endocrine glands.
5. Symptoms and disorders related to changing hormonal level.