GONDWANA UNIVERSITY, GADCHIROLI

DIRECTION RELATING TO THE EXAMINATION LEADING TO THE TWO YEAR / ONE YEAR MASTER OF SCIENCEDEGREE WITH SEMESTER PATTERN

AS PER NEP 2020

FACULTY- SCIENCE AND TECHNOLOGY

SUBJECT- ZOOLOGY

M.Sc. Semester I and II

Session 2023-24

M.Sc. Semester I Admission

1. Details of Eligibility for M.Sc. Semester I Admission

Subject to their compliance with the provisions of this direction and of other ordinances in force from time to time, the following applicant candidates shall be eligible for the admission to Master of Science in Zoology and examinations their of

Table 1: Eligibility for M.Sc. Semester I Admission

A	For M.Sc. Zoology) Semester-I	For admission to the M. Sc. Semester I in Zoology, a candidate shall have offered Zoology as one of the Major subjects at the qualifying B.Sc. Examination

Candidates shall have passed any one of the above examinations from Gondwana University Gadchiroli or any other statutory University of India or abroad, recognized by the UGC or any other concerned apex regulatory authority / body of India.

2. Duration of the Program, Student Progression Path and Provisions for Multiple Exit

Duration of the M.Sc. shall be TWO years with the provision for exit at the end of first year

Exit Option:

Students will have the flexibility to enter a program in odd semesters and exit a program after the successful completion of even semester as per their future career needs:.

a. A student can exit the program after successful completion of semesters I & II having earned requisite number of credits as mentioned in the scheme of examination. Such a student shall be eligible for the award of **'PG Diploma in Major Subject'** by the affiliated colleges of Gondwana University

OR a student can continue the program in 2nd year.

b. A student, on successful completion of all the 4 semesters and having earned requisite number of credits as mentioned in the scheme of examination shall be eligible for the award of either **'Master of Science Degree with Major subject'**.

Table 2: Eligibility for Award of Certificate/Diploma/Degree/Honours or Research Degree

Qualification Title	Credit Earned	Semester	Year
PG Diploma in Major Subject	40	2	1
Master of Science Degree with Major subject	80	4	2

3. Credit Specifications:

a. Theory Courses: One hour/credit/week (a minimum of 15 hours of teaching per creditis required in a semester.

b. Laboratory/Performance Based Courses: A minimum of 30 hours in laboratory or Performance Based activities is required in a semester. Performance based activities include Workshop based activities, internship, Apprenticeship; Field based learning, community engagement learning, etc.

c. Each semester will consist of at least 15 weeks of Academic Work equivalent to 90 actual teaching days.

4. Assessment

Assessment Plan will consist of Continuous Internal Evaluation (CIE) and End Semester Evaluation (ESE) for each course/subject taken together.

(A) Continuous Internal Evaluation (CIE) will be based

(a) Attendance of the student during a particular semester

(b) An assignment (min. two) based on curriculum to be assessed by the teacherconcerned

(c) Subject wise class test (min. two) or activities conducted by the teacher concerned with proper rubrics.

(B) Expected classroom activities shall consist of Group Discussion, Seminars, Power Point Presentations, Elocution, Debate, Role Play, Case Studies, Educational Games etc . The teacher is expected to undertake a minimum of four of the aforesaid activity.

(C) The CIE marks will be communicated to the examination cell at the end of each semester, but before the semester end examinations / as instructed by the Examination Cell. These marks will be considered for the declaration of the results.

(D) The record of internal marks, evaluation & results should be maintained for a min. period of three year by the respective department for verification by the competent authority.

5. Standard of Passing

The scope of the course, percentage of passing in Theory and Project and Internal Assessment will be governed as per following rules:

(i) In order to pass the Master of Science (M.Sc.) 1st, 2nd, 3rd, and 4th Semester Examinations, an examinee shall obtain not less than 40 % (Grade 4) marks in each theory course / paper, taking CIE & SEE together. Whereas, for practical / performance-based examination an examinee shall obtain not less than 50 % marks in each practical, taking CIE & SEE together.

(ii) An examinee who is unsuccessful at the examination shall be eligible for admission to the subsequent examinations on payment of a fee prescribed for the examination together with the conditions of the ordinance in force from time to time.

6. General Guidelines

a. With effect from Academic Year 2023-24, Two years Master's Degree Program will be revamped as per the Illustrative Credit Distribution given in the above Table.

b. Under the One-year PG Diploma program, and two-year master's Degree program, the students must complete on-the-job training/internship of 04 credits during summer break, after completion of the second semester of the first year in the respective Major Subject.

c. The 4 Credits Research Methodology Component is mandatory in the First Year.

d. Electives selected in the PG program may be Relevant to OR Supportive of the Major Subject chosen.

e. The students will have to undertake a research project of 4 credits in Semester III and a research project of 6 credits in Semester IV in the second year of the two-year master's degree program. This is also applicable to the students admitted to one year PG program after completion of four years UG Program.

f. The exit option at the end of one year of the Master's degree program will commence from AY 2024-25. Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and earn a PG Diploma.

g. The PG Diploma may be awarded to a student provided they have earned the requisite credits in one year including on-the-job training of 04 credits during summer break, after completion of the second semester of the first year in the respective Major Subject.

h. Successful examinees at the M. Sc. Sem I, II, III, and IV Examinations shall be entitled

to receive a grade card signed by the **Controller of Examination and Evaluation of Gondwana University Gadchiroli** and successful examinees opting for the exit at the end M. Sc. Sem II and IV Examinations shall, on payment of prescribed fees, receive a Degree certificate in the prescribed format from Gondwana University.

M.SC. SEMESTER I &II

Model Question Paper

Zoology Core Course/ Open Elective (OE)/ Research Methodology

Time: 3 Hrs Maximum Marks: 80

Instructions to Candidates:

1. All sections/parts are compulsory.
2. Draw neat labelled diagrams wherever necessary.
3. There will be five descriptive questions, each carrying 16 marks.

Qu. I. Long Question Unit 1 (16x1= 16)

OR

A) Short Question (8x2= 16)

B) Short Question

Qu. 2. Long Question Unit II (16x1= 16)

OR

A) Short Question (8x2= 16)

B) Short Question

Qu. 3. Long Question Unit III (16x1= 16))

OR

A) Short Question (8x2= 16)

B) Short Question

Qu.4. Long Question Unit IV (16x1= 16))

OR

A) Short Question (8x2= 16)

B) Short Question

Qu. 5. Attempt to the following (4x4= 16)

1. Unit I
2. Unit II

4. Unit III
5. Unit IV

2. Practical Examination Assessment (2 Credits Each)

a. Practical I based on CC1 and CC2, of 100 marks - (20 Marks for Practical CA + 80 marks for Practical UA)

b. Practical I based on CC3 and OE, of 100 marks - (20 Marks for Practical CA + 80 marks for Practical UA)

c. For passing, student must score minimum 50 marks out of 100 in practical examination based on Lab-I and Lab-II

3. OJT / FP Internship / Apprenticeship / Field Project/ Patent (Related to DSC) - (20 Marks of CA + 80 Marks of UA)

Table showing semester wise total marks in Theory and Practical

Semester	Theory	Practical	Total Marks	Credits
1	550	200	750	20
II	550	200	750	20
III	550	200	750	20
IV	550	200	750	20
For Honors	2200	800	3000	80

Total Credits:

Cumulative Credits required for PG in Major Subject (One Year PG Degree) = 40 Credits

Cumulative Credits required for PG in Major Subject (Two Year PG Degree) = 80 Credits

Teaching and Examination Schemes:

Teaching and Examination Schemes Two Year M.Sc. (of four semesters) programme is as follows.

Table 1: M.Sc. Semester I

Sr No	Course Category	Name of the course(Title of the Paper)	Level	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Th	Tu	P		Duration of Exam (Hrs)	UA (ESE)	CA (CIE)	Mini Passing Marks
1	DSC	Paper 1:- Structure and function of Invertebrates (01MSCZO01)	6.0	4	--	--	3	3	80	20	40
		Paper 2:- General Physiology (01MSCZO02)		4	--	--	3	3	80	20	40
		Paper 3:- Cell Biology and Genetics (01MSCZO03)		4	--	--	3	3	80	20	40
2	DSE Elective	**Paper 1:-** Bioinstrumentation, Bioinformatics and Biostatistics **Paper 2:-** Environmental science and Basic concepts of Ecology **Paper 3:-** Ecology and Environmental Pollution **Paper 4**:- Medical Laboratory Techniques **Paper 5**:- Basic Limnology (01MSCZO04)		4	--	--	3	3	80	20	40
3	RM	Research Methodology (01MSCZO05)		4	--	--	4	5	80	20	40
4	Lab-I	Practical Basis On (C1+ C2)		--	--	4	2	5	80	20	50
5	Lab-I	Practical Basis On (C1+ EL)		--	--	4	2	5	80	20	50
6		Seminar		---	--		--	--	--	50	20
				20	--	8	20		550	200	--

Cumulative Credits required for PG in Major Subject (One Year PG Degree) = 20 Credits
Subject Core = 09, Practical = 04, Electives = 03 , RM = 4, Total = 20 Credits

Table 1: M.Sc. Semester II

Sr No	Course Category	Name of the course(Title of the Paper)	Level	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical		Duration of Examination (Hrs)	End Semester Evaluation(ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
				Th	Tu	P					
1	DSC	Paper 1:- Structure and Function of Vertebrates (02MSCZO01)	6.0	4	--	--	3	3	80	20	40
		Paper 2: Comparative Endocrinology- (02MSCZO02)		4	--	--	3	3	80	20	40
		Paper 3 Molecular Biology and Biotechnology: (02MSCZO03)		4	--	--	3	3	80	20	40
2	DSE Elective	Paper 1:- Biology of Parasites Paper 2:- Aquaculture and Management Paper 3:- Applied Entomology Paper 4:- General and Applied Ichthyology Paper 5:- Economic Zoology (02MSCZO04)		4	--	--	3	3	80	20	40
3	OJT / FP	Industrial Training/Survey/ Research Project (02MSCZO05)		4	--	--	4	5	80	20	50
4	Lab-I	Practical Basis On (C1+ C2)		--	--	4	2	5	80	20	50
5	Lab-I	Practical Basis On (C3+ EL)		--	--	4	2	5	80	20	50
6		Seminar		---	--		--	--	--	50	20
				20	--	8	20		550	200	--
Cumulative Credits for : PG Degree in Major Subject Core = 09, Practicals = 04, Electives = 03 OJT / FP= 4 Total = 20 Credits (Sem-1: 20 + Sem-2: 20 = 40 Credits											

M.Sc. Part I Semester –I Zoology

Paper-I, Structure and function of Invertebrates (01MSCZ001)

NEP-2020 (Core DSC) Credits-3 Marks – 80

Unit-I **(15 Hrs)**

1.1 Classical and molecular taxonomic parameters, species concept, systematic gradation of animals, nomenclature, modern scheme of animal classification into sub-kingdom, division, section, phyla and minor phyla.

1.2 Ultrastructure of protozoan locomotory organs (pseudopodia-cytoplasmic organelles, flagella, cilia and pellicular myonemes) and mechanism of various modes of locomotion.

1.3 Dermal cells and skeletal organization in calcareous sponges, Hexactinillida and Demospongiae (Porifera).

1.4 Polymorphism and metagenesis in coelenterate. Types of polyps, medusa and metamorphosis.

Unit-II **(15 Hrs)**

2.1 Origin of metazoan- Colonial, syncytial and molecular theories.

2.2 Reproductive system-structure and mechanism of reproduction in Dugesia, Fasciola, Taenia and Ascaris.

2.3 Formation, Evolution and significance of coelom, metamerism and symmetry in classification of animals particularly coelomata.

2.4 Evolution of nephridia and mechanism of excretion (nitrogenous excretory products, transport of water and salts) in Polychaeta, Oligochaeta and Hirudinea of Annelida.

Unit-III **(15 Hrs)**

3.1 Peripatus (Onychophora) structure, affinities and taxonomic position.

3.2 Respiratory organs in Arthropoda. Mechanism of gaseous exchange in tracheal respiration in Insecta and gill respiration in Crustacea.

3.3 Neopilina (Monoplacophora): structure, affinities and taxonomic position.

3.4 Neuroanatomy in Gastropoda, Bivalvia and Cephalopoda.

Unit-IV **(15 Hrs)**

4.1 Water vascular system in Echinodermata: structure and functions.

4.2 Larval forms in Echinodermata: Metamorphosis and phylogenetic significance.

4.3 General account and affinities of Ctenophora and Rotifera.

4.4 General account and affinities of Entoprocta and Ectoprocta.

Books Recommended for Structure and function of Invertebrates

1. Hyman L.H. The Invertebrate Vol. I, Protozoa through Ctenophora. McGraw-Hill Co., New York.
2. Barrington E.J.W. Invertebrate structure and function. Thomas Nelson and sons Ltd., London.
3. Jagerstein G. Evolution of Metazoan life cycle . Academic press, New York and London.
4. Hyman L.H. The invertebrate vol. 2 McGraw-Hill Co., New York.
5. Hyman L.H. The invertebrate vol. 8 McGraw-Hill Co., New York.
6. Barnes R.D. Invertebrate Zoology W.B. Saunders and Co., Philadelphia
7. Russet Hunter W.D.D. biology of higher invertebrate The Macmillan Co. Ltd., London.
8. Hyman L.H. The Invertebrates, smaller coelomate groups. Vol. 5 McGraw-Hill Co. New York.
9. Read C.P. Animal Parasitism. Prentice Hall. New-Jersey.
10. Kudo R.R. (1966) Protozoology, Charler, C. Thomas Springfield, Illinois.
11. Barradailes L.A. and potts F.A. Invertebrates (1961) The Eastham L.E. S. Saunders, Cambridge University Press, Cambridge.
12. Russel W.D. Hunter, Biology of lower invertebrates McMillan, New York.
13. Marshall A.J. and Williams W.D. (1972) J. B. Zoology of Invertebrates ,ElBs and McMillan, London.
14. Gtryyrt V. and Graham A. A Functional anatomy of Invertebrates. Academic press, New York.
15. Backlemiccher W.N. Principles of comparative anatomy of Invertebrates Oliver and Boyed Edinberg.
16. Hadisi J. The Evolution of Metazoa. Pergamon Press, Oxford.
17. Dales R.P. Annelids, Hutchinson, London.
18. Green J. Biology of Crustacea, Wither by, London.
19. Morton J. E. Mollusca, Hutchinson, London.
20. Nichols D. Echinodermata, Hutchincon, London.

M.Sc. Part I Semester –I Zoology

Paper-II, General Physiology (01MSCZ002)

NEP-2020 (Core DSC) Credits-3 Marks – 80

Unit-I **(15 Hrs)**

1.1 Enzyme: Classification, mechanism of enzyme action. Factors affecting enzyme action, regulation of enzyme activity, activators and inhibitors.

1.2 Respiratory pigments- types, distribution and properties, structure of haemoglobin and mechanism of O2 transport.

1.3 Neurotransmitters: chemical nature, biosynthesis and mechanism of synaptic transmission.

1.4 Colour change mechanism: Chromatophores and melanophores- structure, physiology and significance.

Unit-II **(15 Hrs)**

2.1 Bioluminescence: light producing organs- distribution in invertebrates and vertebrates, physiology and significance.

2.2 Thermoregulation in poikilotherms and homeotherms, adaptations and regulatory mechanisms.

2.3 Osmoregulation in Pisces and Amphibia, mechanism of salt and water transport by gills and kidney.

2.4 Molecular mechanism of peptide and steroid hormonal action. Membrane receptors and signal transduction.

Unit-III **(15 Hrs)**

3.1 Myogenic and neurogenic heart, Cardiac cycle- Phases of cardiac cycle, ECG pace maker, and heart valves.

3.2 Digestion and absorption of carbohydrate, proteins and lipids in the gastrointestinal tract.

3.3 Carbohydrates- classification and metabolism- glycogenesis, glycogenolysis, glycolysis, TCA cycle, electron transport system and oxidative phosphorylation.

3.4 Lipids- classification and metabolism- oxidation of fatty acids, cholesterol metabolism. Proteins- classification and metabolism- oxidative deamination, decarboxylation and transamination of amino acids, arginine-ornithin cycle.

Unit-IV **(15 Hrs)**

4.1 Hydromineral metabolism-water electrolyte balance, mineral metabolism in bone and egg shell formation.

4.2 Cerebrospinal fluid: Chemistry and functions.

4.3 Mechanism of reflex action.

4.4 Physiology of environmental stress and strain- tolerance, avoidance, resistance and Physiological adaptations.

Books Recommended for General Physiology

1. Text Book of Physiology & Biochemistry: Bell, G.E. & Davidson, J.N. &Emslie D. Smith, 1922.

2. Medical Physiology: A Wiley Medical Publication, John Wiley & Sons, New York.

3. Mineral Metabolism: Comar, C.L. & Felix Bronner (1961) Acad Press, New York & London.

4. A Text Book of General Physiology: Dayson (1964): Little Brown & Co. Boston.
10

5. Animal Physiology: R. Eckert & D. Randall (1983) 2nd Edn., W.H. Rexeman& Co.

6. Biochemistry & Physiology of the Cell: (2nd Edn.), M.A. Edwards & K.A. Hassall (1980) Mc. Graw Hill Co.

7. The Physiology of Cells: Cuthe F. (1968): The Macmillan Co.

8. Textbook of Medical Physiology: Guyton, A.G. (1968). 7th Edn. Saunders Pub.

9. Samson Wrights Applied Physiology: Oxford University Press.

10. Comparative Animal Physiology C.L. Prosser, W.B. Saunders & Company.

11. Animal Physiology: Mechanism & Application, R. Eckert, W.H. Freeman & Company.

12. General & Comparative Animal Physiology: W.S. Hoar.

13. Medical Physiology: W.F. Ganong (1981): 10th Edn. Lange Medical Publications.

14. Principles of Anatomy and Physiology: Tortora Grabowski, 9th Edn. John Willey & Sons.

15. Reproductive Physiology of Vertebrates: Van Tienhoven, A. (1983): 2nd Edn. Cornell Univ. Press, New York.

Semester I- Practical-I: Structure and Function of Invertebrates and General Physiology

(CREDIT - 2)

Section-A

1 Study of museum specimens using already available specimens in the museum/ charts/ models/ photographs/ digital alternatives etc.

Classification upto order and comments on the specimens representing all phyla.

2 Anatomical Observations

Anatomical observations, demonstration and detailed explanation of

a) Digestive system of Earthworm, Leech, Cockroach, Silkworm and Honey bee

b) Nervous system of Prawn, Cockroach, Silkworm and Honey bee and

c) Reproductive system of Earthworm, Leech, Cockroach and Honey bee with the help of ICT tools/ Models/ Charts/ Photographs etc.

3 **Mounting- Whole mount preparation of plankton and/or study of permanent**

Preparation of the following with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

a. Earthworm – Nerve ring, ovary, spermatheca, nephridia.

b. Leech – jaws, ciliated organ.

c. Cockroach – Mouth parts, Salivary glands, trachea.

d. Prawn –Appendages, Statocyst.

e. Protozoans- rhizopods , flagellates , ciliates (fresh water forms).

f. Porifera – Spicules and gemmules of fresh water sponges.

g. Crustaceans and rotifers - Planktonic copepodes, cladoceran, ostracoderm and rotifers.

h. Larval forms of the free living invertebrates.

i. Larval forms of parasitic invertebrates.

4 Study of permanent Invertebrate slides

a. Porifera – T.S. and L.S. of Sycon, gemmules, spongianfibres, spicules

b. Coelenterata – T.S. of Hydra , T.S. of Sea anaemon, Ephyra larva

c. Helminths – T.S. of Planaria, T.S. of Taenia , scolex W.M., Mature , gravid proglotids , T.S. of male and female Ascaris, W.M of Ancylostoma , Enterbios, Dracunculus,Wuchereria

d. Annelida -T.S. of Nereis, T.S. of Earthworm, T. S. of Leech.

e. Arthropod larvae – Nauplius, Zoea, Metazoea, Megalopa, Mysis.

f. Mollusca – T.S. of foot, Veliger and Glochidium larva.

g. Echinodermata- pedicellarae, T.S. of arm of star fish, Bipinnaria, Auricularia larva.

h. Hemichordata – T.S. through collar, proboscis, trunk and branchio-genital regions. Tornaria larva.

Section-B

Physiology experiments –

a. Total leucocyte count and differential leucocyte count.

b. Total R.B.C. count.

c. Demonstration of action of salivary amylase, trypsin, pepsin.

d. Demonstration of rate of O2 consumption in aquatic animals, under various environmental stresses.

e. Demonstration of haemoglobin concentration in normal and pathological condition.

f. Estimation of sodium, potassium and chloride in blood and excretory organs by Colorimeter or flame photometer (Source of blood: Local recognized pathology laboratory).

g. Estimation of glucose in blood by spectrophotometer or Colorimeter (Source of blood: Local recognized pathology laboratory).

h. Estimation of total blood proteins by spectrophotometer or Colorimeter (Source of blood: Local recognized pathology laboratory).

i. Estimation of cholesterol in blood by spectrophotometer or Calorimeter (Source of blood: Local recognized pathology laboratory).

Distribution of Marks: Marks

1. Anatomical observations	05
2. Stained permanent preparation:	05
3. Identification and comment on the spots (1-10)	20
4. Physiology experiment (Major)	15
5. Physiology experiment (Minor)	10
6. Submission of stained permanent slides	05
7. Class Record	10
8. Viva-voce	10
Total marks	80

M.Sc. Part I Semester –I Zoology

Paper-III, Cell Biology and Genetics (01MSCZ003)

NEP-2020 (Core DSC) Credits-3 Marks – 80

Unit-I **(15 Hrs)**

1.1 Membrane structure and functions- Structure of model membrane, lipid bilayer, membrane proteins, diffusion, osmosis, active transport, uniport, multiport, symport, antiport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membrane.

1.2 Structural organization and functions of cell organelles- Nucleus, mitochondria, endoplasmic reticulum, Golgi complex, lysosomes and peroxisomes.

1.3 Structure and Functions of microfilaments, microtubules, intermediate filaments and their role.

1.4 Cell division and cell cycle- Phases of cell cycle, checkpoints of cell cycle, regulation of cell cycle, mitosis and meiosis.

Unit-II **(15 Hrs)**

2.1 Cell signaling- Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, Receptor protein- tyrosin kinase and ion chanel receptors.

2.2 Signal transduction pathways, primary and secondary messenger systems, regulation of signaling pathways.

2.3 Cellular communication - general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix and integrins.

2.4 Cancer - genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis.

Unit-III **(15 Hrs)**

3.1 Mendelian, non-Mendelian inheritance- Mono/dihybrid inheritance, types of dominance, multiple allelism, probability, exercises for solving genetics problems.

3.2 Extensions of Mendelian principles- Codominance, incomplete dominance, gene interactions, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

3.3 Quantitative Genetics - polygenic traits and mode of inheritance, analysis of variation, genetic and environmental factors, heritability, inbreeding and consequences, coefficient of inbreeding and consanguinity.

3.4 Mutation - types, causes and detection, mutant types- lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutations.

Unit-IV **(15 Hrs)**

4.1 Structural and numerical alterations of chromosomes- Deletion, duplication, inversion, transversion, translocation, ploidy and their genetic implications.

4.2 Extra chromosomal inheritance- Cytoplasmic inheritance, inheritance of mitochondrial genes, maternal inheritance.

4.3 Microbial genetics- Recombination in bacteria and gene mapping, transformation, conjugation, transduction (generalized and specialized), fine structure mapping of genes.

4.4 Human genetics- Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Book Recommended for Cell Biology and Genetics

1. Cell and Molecular Biology by De Robertis- E. D. P., I. S. E. publication.
2. Molecular Biology by Turner P. C. and McLennan , Viva Books Pvt. Ltd.
3. Advanced Molecular Biology by Twyman R. M., Viva Books Pvt. Ltd.
4. Molecular Biology by Freifelder D., narosa publication House.
5. Gene VI by Benjamin Lewis, Oxford press.
6. Gene VIII by Benjamin Lewis, Oxford press.
7. Molecular biology of Gene by Watson J. D. et. al., Benjamin publication.
8. Molecular cell Biology by Darnell J. Scientific American Books USA.
9. Molecular Biology of the Cell by Alberts B., Bray D. Lewis J., garland publishing Inc.
10. Genetics Vol. I and II by Pawar C. B., Himalaya publication.
12. Essentials of Molecular Biology by Freifelder D., narosa publication House.
13. Molecular Cell Biology by Laodish H., Berk A., Zipursky S. L., Matsudaira P., Baltimore D. and Darnell J., W. H. Freeman and Co.
14. The Cell: Molecular Approach by Cooper G. M.
15. Molecular Biology by Upadhay A and Upadhay K. Himalaya publication.

Semester-I, Practical-II, Cell Biology, Genetics (C3) (CREDIT - 1)

Practical Based on C3 (Credit -1) + Any one of Major Elective (Credit -1)

Section-A

1. Study of mitotic metaphasic chromosomes in plant material.
2. Preparation of human karyotypes by using photographs/pictures.
3. Demonstration of drum-stick in human female leucocyte and Barr body in buccal epithelium.
4. Demonstration of polytene chromosome in dipteran larvae with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
5. Problems on genetics based on monohybrid/dihybrid ratios, sex linked inheritance and blood groups.
6. Study of various human genetic traits by employing Hardy-Weinberg Equations.
7. Microscopy: Handling of Dissecting, Stereo and Compound microscopes.

Genetic study of model organisms and their significance:

a) Bacteriophage – Lambda phage
b) Bacteria: E. coli.

c) Saccharomyces

d) Coenorhabditis elegans

e) Drosophila melanogaster

f) Arabdopsis thaliana

g) Rattus albicans

8. Staining Techniques:

a) RNA and DNA- Methyl green and Pyronin

b) Mitochondria- Janus green

c) Lactobacillus and E. coli- Gram Staining

9. Observation of Mitotic stages in permanent slides

10. Temporary squash preparation of Onion root tips for mitosis

11. Study of meiotic chromosomes and spermatogenesis in grasshopper with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

Distribution of Marks	**Marks**
1. Cytological preparation	10
2. Any Experiment from genetics	10
5. Identification and comment on spots (1-5)	10
6. Class record	08
7. Viva-voce	02
Total marks	40

M.Sc. Part I Semester –I Zoology

Paper – Bioinformatics, Biostatistics and Bio techniques (01MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks – 80

Unit-I **(15 Hrs)**

1.1 Introduction and scope of bioinformatics- History, scope of bio-informatics in research, business and employment opportunities.

1.2 Bio-informatics in India. Sequence alignment- Pair wise sequence alignment and multiple sequence alignment.

1.3 Biological databases– Basic local alignment search tool (BLAST), and FASTA, Variants of BLAST, PSI-BLAST.

1.4 Phylogeny analysis- Tree style, tree building.

Unit-II **(15 Hrs)**

2.1 Collection and Presentation of Biological data,

2.2 Measures of central tendency (individual observations, discrete and continuous series), Mean (simple and weighted), Median, Mode (analysis using group table)

2.3 Measures of dispersion (individual observations, discrete and continuous series)

2.4 Range and mean deviation, Standard deviation

Unit-III **(15 Hrs)**

3.1 Correlation and regression, Types and methods of studying correlation,

3.2 Karl Pearson's coefficient of correlation and determination Regression equation (X on Y and Y on X), Regression lines.

3.3 Tests of significance and their application, t-test, Chi-square test

3.4 Analysis of variance: One-way and two-way ANOVA

Unit-IV **(15 Hrs)**

4.1 Basic principles of microscopy, Phase contrast microscope,

4.2 Electron microscope, Fluorescence microscope, Confocal microscopes

4.3 Centrifuge: principle, types of rotors, high speed and ultra-centrifuge, pH Meter,

4.4 Chromatography: Paper, Gel Filtration, Ion exchange, HPLC, ELISA.

Books Recommended for Bioinformatics, Biostatistics and Bio techniques

1. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub. New Delhi.

2. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of SpringerScience+BusinessMedia, 2007.

3. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
4. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.
5. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, structure and databanks. Oxford University Press.
6. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
7. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills: Shroff Publishers and Distributors Pvt. Ltd. (O'Reilly), Mumbai
8. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
9. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell
10. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
11. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners.
12. Elements of Biostatistics: S. Prasad, Rastogi Publication Meerut, 3rd Revised Ed., 2013-2014.
13. Bioinformatics: R. Sundarlingam and V. Kumaresan, Published by Saras Publication, Nagercoil, 2nd Ed., 2013.
14. Bioinformatics: Instant Notes Westhead et al 2003 Viva Books.
15. Biophysical Chemistry: Principle and Techniques – Upadhyay, Upadhyay and Nath, Himalaya Publishing House, New Delhi. Rev.Ed., 2009.
16. Biophysical Chemistry- James P. Allen, Published by- A John Wiley & Sons, Ltd., Publication, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK, 1st Ed., 2008.

PRACTICALS:

Bioinformatics:

1. Accessing EBI Website for downloading and entry of Human Lysosomal Alpha Glucosidase gene.
2. Accessing EBI query website for downloading a file.
3. Accessing of GenBank website and downloading of files.
4. Accessing EMBL website and Cross-link to GenBank.
5. Accessing DDBJ website for downloading a file.
6. Accessing a SWISS-PROT database and downloading Protein sequence.
7. Accessing PDB website and downloading a file of Protein structure.
8. BLAST similarity search for Nucleotide Sequences.
9. BLAST similarity search for Amino acid Sequences.
10. FASTA similarity search for Nucleotide Sequences.
11. FASTA similarity search for Amino acid Sequences.

Biostatistics: Problems related to

1. Mean
2. Standard Deviation
3. Students 't' test
4. Chi – square test

Bio-instrumentation:

Basic principles and functioning of Microtomy, Spectrophotometry, Flame photometry, Spectrophotometry, Paper and thin layer chromatography, pH-meter, Vortex mixture, Centrifugation,

Distribution of Marks	**Marks**
1. Any one experiment from Bioinformatics (1-11)	10
2. Any Experiment from Bio-statistics (1-4)	10
5. Any one from Bio-instrumentations	10
6. Class record	08
7. Viva-voce	02
Total marks	40

M.Sc. Part I Semester –I Zoology

Paper – Environmental Science and Basic Concepts of Ecology (01MSCZ004)

NEP-2020 (Major Elective) Credits -3 Marks -80

Unit – I **(15 Hrs)**

1.1 Ecosystem : Structure and functions of Marine (Oceans), Freshwater (Ponds, Streams, Lakes, rivers) , Grassland, Desert Ecosystems.

1.2 Food Chain, Food Web and Ecological Pyramids and Energy flow in the ecosystems.

1.3 Planktons : Types, Distribution, Seasonal Succession, qualitative and quantitative estimation of zooplankton.

1.4 Nekton and Benthos : Nature, distribution , collection, preservation and importance.

Unit –II **(15 Hrs)**

2.1 Eutrophication : Definition, types, effects and control measures.

2.2 Sedimentary Cycles : Phosphorus, Nitrogen and Sulphur.

2.3 Biogeochemical and Gaseous Cycles: Water , Oxygen and Carbon cycles.

2.4 Biotic Community : Definition, Concept, Characteristics of Community, Community structure, Ecotone and Edge effect.

Unit –III **(15 Hrs)**

3.1 Ecological Niche, Ecotypes, ecophene and Ecological Indicators.

3.2 Ecological Succession : Definition, types, process of ecological succession, significance.

3.3 Biosphere: Major biomes of the world with emphasis on Indian biomes.

3.4 Biological Rhythms: Photoperiodism, Biologial Clock and annual and lunar periodicity.

Unit –IV **(15 Hrs)**

4.1 Population Dynamics : Population structure, pattern of population distribution, population growth and density relationship, population fluctuation and dispersal of population, Life Tables.

4.2 Abiotic Environmental Factors : Limiting factors, temperature and Light, Classification of organisms according to temperature tolerance and regulation, Effects of temperature on plants and animals, Effect of light on animals, Sol formation, soil profile.

4.3 Ecological Adaptations of Aquatic Flora and Fauna: kinds of adaptations, primary and secondary aquatic adaptations, freshwater, estuarine, marine, intertidal and deep sea

adaptations, Marine biodiversity conservation programme, Marine biosphere reserves in India.

4.4 Ecological Tools and Techniques : Sampling techniques of populations, sampling of animal populations, methods of measuring primary productivity, methods of measuring consumer production.

Reference Books

1. Wetzel : Limnology, 3rd Edition.
2. Hutchinson G.E.(1967). A Treatise on Limnology, Vol. II, Introduction to Lake Biology and the Limnoplankton, John Wiley and Sons Inc. New York.
3. Wallace R.A.(1990). Biology - The World of Life, Harper Collins Publications.
4. Smith T.L. and Smith R.L.(2007). Elements of Ecology, Pearson Education.
5. Southwick C.H.(1976).Ecology and the Quality of Our Environment, D.Van Nostrand Company,New York.
6. P.S.Verma,V.K.Agrawal (2005). Environmental Biology (Principles of Ecology), S.Chand and Co.Ltd. New Delhi.
7. P.D.Sharma (2005). Ecology and Environment, Rastogi Publications, Meerut.
8. Odum E.P.(1971). Fundamentals of Ecology, Saunders & .Co.Tokyo, Japan.
9. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches, CABI Publications, U.K.
10. Dr.Sunita Hooda and Dr.Sumanjeet Kaur (1997). Laboratory Manual for Environmental Chemistry, S.Chand and Co.Ltd.New Delhi.
11. Daubenmire R.F.(1968). Plant Communities, Harper and Row, New York.
12. Clarke G.L.(1965). Elements of Ecology, John Wiley, New York.
13. Chatwal G.R. and Sharma Harish (2005). A Text Book of Environmental Studies, Himalaya Publishing House, New Delhi.
14. Boughey A.S.(1968). Ecology of Populations, The McMillan Co. New York.
15. Bharucha Erach (2005). A Text Book of Environmental Studies, Universities Press, Hyderabad.
16. Arora Mohan P.(2004). Ecology, Himalaya Publishing House.
17. Agrawal V.P.(1988). Forests in India, Oxford & IBH Publishing Company Pvt.Ltd. New Delhi.
18. Whittakar R.H. (1970).Communities and Ecosystems, Mcmilan and Co. New York.
19. Wodbury A.M.(1954). Principles of General Ecology, McGraw Hill Book Co. New York.
20. Krebs C.J.(1985). Ecology, 3rd Edition, Harper and Row, New York.
21. Pimm S.L.(1982). Food Webs, Chapman and Hall, London.

Practical's / Field work :

1. Plankton Study (Qualitative): Phytoplankton and Zooplankton.

2. Quantitative Study of Freshwater Zooplankton using S-R Cell.

3. Identification of Insects, Crustaceans and Mollusca from freshwater lake with the help of available specimens, permanent slides, Charts, Models, Photographs and ICT Tools.

4. Determination of Dissolved Oxygen by in Pond /Lake Water Sample by Winklers Iodide-Azide Method.

5. Estimation of Carbon Dioxide from pond water sample.

6. Estimation of Alkalinity of a pond water

7. Estimation of Total hardness of pond water

8. Measurement of primary productivity of a lake by light and dark bottle method

7. Identification of Micro and Macro Benthic forms present in freshwater lake /river/pond.

8. Study of freshwater fishes – Catla, rohu, mrigal, silver carp, grass carp, tilapia, clarias, H.fossilis, wallago attu, mystus, Notopterus, ambassis, puntius, rasbora, gold fish.

8. Visit to a local area to document environmental assets of rivers/forest/grassland/hill/mountain.

9. Visit to a local polluted site urban/rural/ industrial to know its status

10. Study of simple ecosystems- ponds, lakes, rivers

Marks Distribution for Practical:

1. Major Experiment	12
2. Minor Experiment	08
3. Spotting (1-10)	10
4. Class record	07
5. Viva-Voce	03
	……..
Total Marks	**40**

M.Sc. Part I Semester –I Zoology

Paper – Ecology and Environmental Pollution (01MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

Community Ecology:

1.1 Habitat and Niche: Concept and types of habitats, Ecological niche, Niche width and overlap.

1.2 Species interaction: Types of interactions, Inter-specific competition, Symbiosis.

1.3 Community ecology: Types and nature of communities, composition of community, Community dominance, edge and stones.

1.4 Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection).

Unit-II **(15 Hrs)**

Ecosystem Ecology:

2.1 Ecological Succession: Characteristics, Types and Patterns of succession, Climax.

2.2 Energy in ecosystem: Productivity and energy flow, energy partitioning.

2.3 Environmental Impact Assessment: concept process and evaluation methodology.

Unit-III **(15 Hrs)**

3.1 Environmental Pollution- Concept, sources of pollution and nature of pollutants, pollution monitoring.

3.2 Air Pollution: Air pollutants, sources, effects of air pollution.

3.3 Smog- formation, Classical smog and industrial pollution, photochemical smog and vehicular emission. Prevention and control of air pollutants.

Unit-IV **(15 Hrs)**

4.1 Water pollution- Sources of water pollution, Nature of water pollutants and their effects, sewage treatment.

4.2 Agricultural pollution- Farm animal waste, Soil erosion plants residues, agrochemical- fertilizers and pesticides.

4.3 Radioactive pollution- types, sources and effects of radiation.

4.4. Noise Pollution- Concept, sources, effects, noise pollution act.

Books recommended for Ecology and Environmental Pollution

1. Fundamentals of Ecology- Dash and Dash.

2. Basic Ecology- Odum E. P

3. Fundamentals of Ecology- Odum E. P
4. Modern concepts of ecology- K. D. Kumar.
5. Concepts of Ecology- H. D. Kumar.
6. Ecology - P. D. Sharma.
7. Environmental pollution Half, Rinehart and Winston, New York (1977) Laurent Hodges.
8. Pandey Kamleshwar., Shuklar J. P. and Trivedi S. P. (2005): Fundamental of Toxicology. New Central book agency PVT. LTD. Kolkata.
9. Santra S. C. (2008). Environmental Science. New central Book Agency (p) Ltd. Hawrda.

Practicals

Experiments on Community Structure Study:

1. To determine the minimum size of the quadrat by species area-curve method.
2. To study communities by quadrat method and to determine % Frequency, Density and Abundance.
3. To determine minimum number of quadrats required for reliable estimate of biomass in grasslands.
4. To study frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkiaer's standard frequency diagram.
5. To estimate Importance Value Index for grassland species on the basis of relative frequency, relative density and relative dominance in protected and grazed grassland.
6. To determine the basal cover, or vegetational cover of one herbaceous community by quadrat method.
7. To measure the vegetation cover of grassland through point-frame method.
8. To prepare a list of plants occurring in a grassland and also to prepare chart along the line transect.

Experiments on Biomass Study:

9. To measure the above-ground plant biomass in a grassland. Or To determine the biomass of a particular area.
10. To determine diversity indices (richness, Simpson, Shannon-Wiener) in grazed and protected grassland. Or, To study species diversity (richness and evenness), Index of dominance, Similarity index, Dissimilarity index and Species diversity index in grazed and protected grassland.

Experiments on Soil Science

10. To study the characteristics of different types of soils.

Experiments on Aquatic Ecosystem

11. To study the biotic components of a pond. Make diagram of a pond ecosystem.

Experiments on Physico-Chemical Analysis of Water

12. To measure temperature and pH of different water bodies.
13. To measure amount of dissolved oxygen content in polluted and unpolluted water bodies.

Or To measure amount of dissolved oxygen in pond water.

14. To count phytoplankton by haemocytometer method.
15. To determine plankton biomass of a pond.
16. Effect of pollution on aquatic life
17. Effect of Pollution on fish
18. The effects of organism on Pollution and the Environment
19. The effects of Pollution on Lakes
20. Effects and control of Oil pollution
21. Collection, Processing and Storage of Effluent Sample
22. Determination of COD, free Carbon dioxide, TDS, Hardness in waste water sample
23. Analysis of waste water/sludge for heavy metals
24. Determination of Sound level by using sound level meter
25. Estimation of non-respirable dust in air by using dust sample
26. Estimation of Respirable dust by using dust sampler

Marks Distribution for Practical:

6. Major Experiment (Community Ecology)	10
7. Major Experiment (Physical, Chemical analysis of water)	10
8. Minor Experiment (Biomass study)	05
9. Minor Experiment (Sound/Noise pollution)	05
10. Class record	07
11. Viva-Voce	03
…….....	
Total Marks	**40**

M.Sc. Part I Semester –I Zoology

Paper – Medical Laboratory Techniques (01MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I (15 Hrs)

1.1 Basic Laboratory Principles - Code of Conduct of Medical Laboratory Personnel.

1.2 Organization and Functioning of Clinical Laboratory.

1.3 Hazards in the Laboratory (Chemical Hazards, Clinical Hazards, Electrical Hazards, Biological Hazards. Waste Disposal.

1.4 Safety Measures - Safety Equipment's, Safety Symbols.

Unit-II (15 Hrs)

2.1 Introduction of Common Laboratory Equipment's: Hot Air Oven, Incubator, Autoclave, Water Bath and Centrifuge, Ultra-centrifuge

2.2 Microscope- Fundamentals of Microscopy, Resolution and Magnification, Light Microscopy,

2.3 Electron Microscopy- Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM).

2.4 Polymerase Chain Reaction Machine (Thermal Cycler) and Process of PCR, Polyacrylamide Gel Electrophoresis (PAGE) and UV-Trans-Illuminator.

Unit-III (15 Hrs)

3.1 Specimen Collection, Processing and Analytical Techniques Collection and Preservation of Blood

3.2 Urine, Stool, Sputum, Pus, Body Fluids and Swab.

3.3 Preparation of Blood Smears.

3.4 Sources of Biological Variations and Pre-Analytical Variables.

Unit-IV (15 Hrs)

4.1 Preparation of Reagents: Buffers , Normal, Percent and Molar Solution, Normal Saline -Methods of Measuring Liquids.

4.2 Clinical Laboratory Records - Modern Laboratory Set Up - Quality Control: Accuracy, Precision, and Reference Values.

4.3 Disposal of Biomedical Waste

4.4 Laboratory Safety Protocols and Guidelines

Reference Book

1. Dr. Praful B. Godkar,Text Books of Medical Laboratory Technology
2. Anathanarayana & Panikar – A Text Book of Medical Microbiology
3. Monica Cheesbrough, District Laboratory Practice in Tropical countries –PartI & Part II
4. . Vasudevan & Shreekumar : Biochemistry for Medical students
6. K.Laxminarayan : Histological techniques
8. Dr. Mukherjee, Medical Laboratory Technology, Volume I , II & II
9. J G College et al, Mackie & Mc Cartney Practical Medical Microbiology, 14th Edn, 1996, London, Churchill Livingstone.
10. Silvertone : Introduction to Medical Lab. Technology
11. Manual for Clinical Pathology by Sabitry Sanyal
12. Chatterjee , KD – Parasitology
13. Bancroft, Cellular Pathology Technique
14. 15. Mamuel Baron, Medical Microbiology, 3rd Ed
16. Clinical Lab Management by Williams & Wilkins

Practical's

1. Estimation of biochemical parameters using Auto-analizer, Semi-autoanalyzer
2. Scanning of absorption spectra of any amino acid on double beam spectrophotometer
3. Determination of Na+ & K+ in blood serum using flame photometer
4. Determination of pH of blood and arterial blood gas analysis.
5. Estimation of various minerals using Atomic absorption spectrophotometer (AAS)
.6. Estimation of various hormones, tumor markers by using Chemiluminescence (CLIA) AND ELISA method.
6. Extraction of glycogen and its estimation
7. Extraction of protein and its estimation
8. Extraction of lipids and estimation of total lipids, glycolipid, phospholipids and cholesterol.
9. Visit to Pathology Laboratory either Government or Private for collecting the information of any diseases or disorders and submit a project report.

Marks Distribution for Practical:

1. Major Experiment	15
2. Minor Experiment	10
3. Project Report	07
4. Class record	05
5. Viva-Voce	03
Total Marks	40

M.Sc. Part I Semester –I Zoology

Paper – Basic Limnology (01MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

Concept of limnology and its importance,

1.1 Physico-chemical properties of water

1.2 Physical conditions: Water current, watercolor, turbidity, and temperature.

1.3 Chemical conditions: pH, carbon dioxide, dissolved oxygen, hardness, alkalinity, nitrate, and phosphate.

1.4 Significance of physicochemical properties of water

Unit-II **(15 Hrs)**

Introduction to freshwater habitats

2.1 Lentic habitat: Lakes, ponds, wetlands, and ephemeral water bodies.

2.2 Thermal stratification in lakes.

2.3 Lotic habitat: Characteristics of lotic habitat,.

2.4 Major rivers in India

Unit-III **(15 Hrs)**

Introduction to minor phyla

3.1 General characters of Zooplankton with two examples
Rotifera, Copepoda, Cladocera and Ostracoda

3.2 Gastrotricha, Bryozoa and Tardigrada (water bears).

3.3 Diversity and economic importance of freshwater Crustacea and Mollusca.

3.4 Study of Macrobenthic animals and Aquatic Insects

Unit-IV **(15 Hrs)**

Diagnostic features and Economic importance of freshwater fishes (two example).

4.1 Locomotory and respiratory adaptation in freshwater insect orders:
Odonata, Coleoptera, Diptera and Hemiptera.

4.2 Respiratory adaptation in freshwater insect orders
Odonata, Coleoptera, Diptera and Hemiptera

4.3 Anthropogenic impact on freshwater:

4.5 Sewage and silage, mining waste, agricultural chemicals, industrial outflows.

Books recommended for Basic Limnology

1. Limnology: lake and river ecosystem, Robert G. Wetzel. Academic Press,3rd edition.
2. Treatise of Limnology. Hutchinson G. E. John Willy Publication, New York (3 volumes).
3. Field Guide to freshwater invertebrates of North America. Thorp and Rogers. Academic press.

4. Environmental Physiology of Animals. Pat Wilmer, Graham Stone and Ian Johnston. Wiley-Blackwell; 2nd edition.
5. Status of freshwater resources of India. Kailash Chandra, Gopi K.C., Rao D.V., Valarmathi K. and Alfred J.R.B. Zoological survey of India, 2017.
6. Freshwater Ecology: Concepts and Environmental Applications of Limnology. Academic press, 2nd edition
7. Freshwater invertebrates of the United States. Robert Pennak. A Wiley Interscience Publication.
8. Freshwater Biology. Whipple and Ward. John Wiley & Sons Inc; 2nd edition (December 1959).
9. Freshwater Invertebrates: Ecology and General Biology. Thorp and Covich. Academic Press, 4th edition.
10. Limnological Methods. Paul and Welch. Mcgraw –Hill publication.
11. Limnological analysis. Wetzel Robert G., Springer Publication

Practical's

1) Estimation of total carbon dioxide and chloride form given water sample
2) Estimation of phosphates forms given water sample**.**
3) Estimation of total nitrate from given water sample.
4) Estimation of calcium and total hardness of given water sample.
5) Estimation of total alkalinity of given water sample.
6) A qualitative and quantitative analysis of zooplankton from a given freshwater sample using Lackey's drop count method/ Sedgwick rafter counting cell.
7) Study of locomotory and respiratory adaptations in aquatic insects and larvae (*Ranatra, Notonecta, Gerris, Bellostoma and Dytiscus*).
8) Identifications economically important freshwater crustaceans and fishes
9) A Compulsory visit to local freshwater body/Eutrophicated water body and preparation of report.

Marks Distribution for Practical:

12. Major Experiment	12
13. Minor Experiment	08
14. Spotting (1-10)	10
15. Class record	07
16. Viva-Voce	03
……..	
Total Marks	**40**

M.Sc. Part I Semester –I Zoology

Paper – Research Methodology (01MSCZ005)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

1.1 Research: Meaning, Objectives, Types of research,

1.2 Literature review, Collection ofliterature from Books and Journals, Digital library, Search of articles - Google Scholar, Pub med, Inflibnet, Medline

1.3 Publishing of Articles: National and International Journals, Selection of Journals, Concepts related to journals- ISSN Number, Peer reviewed Journals, Science citation index, Impact factor.

1.4 Dissertation: Structure, Components – Introduction, Review of literature, Materials and Methods, Presentation of Results, Discussion, Conclusions, Summary,Arrangement and how to quote references in thesis, Appendix.

Unit-II **(15 Hrs)**

2.1 Data Collection: Meaning, Methods and Tools of Data Collection

2.2 Hypothesis Sampling, Data Processing, Analysis and Interpretation of Data.

2.3 Quantitative methods: Biostatistics used for analysis of Biological data

2.4 Computer application: Bioinformatics, Databases and their applications.

Unit-III **(15 Hrs)**

3.1 Tools and techniques: Techniques used in Purification and characterization of biomolecules: NMR, MALDI-TOF, X-ray crystallography, Circular Dichroism CD

3.2 Microscopic techniques including Fluorescence microscopy, Confocal microscopy, Atomicforce microscopy and live cell imaging FACS analysis.

3.3 Real time PCR, DNA microarray, New generation DNA sequencing, Protein Microarray.

4.4 Polyacrylamide Gel Electrophoresis (PAGE), Western Blotting, Southern Blotting,Northern Blotting.

Unit-IV **(15 Hrs)**

4.1 Intellectual property rights and patent law: Trade Related aspects of Intellectual Property Rights, Reproduction of published material- Plagiarism, Citation and Acknowledgement Patent Criteria and Procedure of patenting.

4.2 Bioethics, Good Laboratory Practice (GLP) and Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) Guidelines-

4.3 Introduction to Bioethics, Bioethic regulation frame work in India, GLP

4.4 Introduction and CPCSEA guidelines for laboratory Animal Facility

Books Recommended for Research Methodology

1. Kothari, C.R. (1985): Research Methodology: Methods and Techniques, Wiley Eastern.
2. Dominowski, R.L. (1980): Research Methods, Prentice Hall Inc., New Jersey.
3. Mishra, R.P. (1980): Research Methodology, Handbook Concept Publishing Company,NewDelhi.
4. IIPS (1996): Research Methodology, IIPS, Mumbai.
5. Research and Writtings – By-P. Ramdas , A.Wilson srunai M.J.Publisher (2009).
6. Scientific thesis writings and Paper presentations-N.Gurumani. M.J.Publisher (2010).
7. Anderson, Durston&Polle 1970: Thesis and assignment, writing Wiley Eastern Limited.
8. G. Vijayalakshmi and C. Sivapragasam. (2008) Research Methods –Tip & Techniques,MJP Publishers, Chennai. WWW.mjppublishers.com
10. Malter K, 1972: Statistical analysis in Biology, Chapmen Hall, London.
11. Cohen, L. Lawrence, M., & Morrison, K. (2005). Research Methods in Education(5thedition) Oxford: Oxford University Press.
12. Leedy, P. D. (1980). Practical Research: Planning and design. Washington: Mc Millan Publishing Co., Inc.
13. Singh, Y. K. (2006). Fundamental of Research Methodology and Statistics. New Delhi.New International (P) Limited, Publisher

M.Sc. Part I Semester –II Zoology

Paper- I, Structure and Function of Vertebrates (02MSCZ001)

NEP-2020 (Core DSC) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

1.1 Origin and ancestry of Chordata.

1.2 General organization and affinities of Cephalochordata.

1.3 Structure, development and metamorphosis of Amoecoetus.

1.4 General characters and affinities of Dipnoi.

Unit-II **(15 Hrs)**

2.1 Organs and mechanism of respiration in Pisces and Amphibia.

2.2 Vertebrate integument and its derivatives.

2.3 Appendicular skeleton (Limbs and girdles) in Amphibia, Reptilia, Aves and Mammals.

2.4 General body organization and classification in Chelonia.

Unit-III **(15 Hrs)**

3.1 Evolution of urinogenital organs in vertebrates.

3.2 Origin of Birds.

3.3 Cetacia: general characters and adaptations.

3.4 Comparative anatomy of the brain in vertebrates (teleost, frog, lizard, fowl and rat).

Unit-IV **(15 Hrs)**

4.1 Autonomous nervous system in vertebrates: structure and functions.

4.2 Evolution of heart in vertebrates.

4.3 Sense organs in vertebrates.

4.4 Evolution of Man.

Books Recommended for Structure and function of Vertebrates

1. Alexander R.N., The Chordata, Cambridge University Press London.

2. Barrington EJW, The Biology of Hemichordates and Protochordates, Oliver and Boid Edinberg.

3. Bourne G.H., The structure and function of nervous tissue Academic press New York.

4. Kingslay J.S, Outlines of Comparative anatomy of vertebrates, Central Book Depot, Allahabad.

5. Honyelli A.R. The Chordates Cambridge University Press, London

6. Smith H.S. Evolution of Chordate structure, Hold Rinehart and Wintoin Inc. New

York
7. Walter H.A. and Sayles L.D. Biology of Vertebrates Macmillan and co. New York
8. Romer A.S. Vertebrate body W.P. Sanders co., Philadelphia.
9. Young J.Z. Life of Vertebrates Oxford University Press, London.
10. Young J.Z. Life of Mammals Oxford University Press, London.
11. Colbert E.H. Evolution of Vertebrates John Wiley and sons Inc. New York.
12. Kent C.J. Comparative anatomy of Vertebrates.
13. Waterman A.J. Chordate Structure and Functions Macmillan Co. New York.
14. Montagna W. Comparative anatomy clarenden press, Oxford
15. Weichert C.K. Preach W. Elements of Chordates anatomy McGraw-Hill book co., New York.
16. Lovetrup S. The phytogeny of Vertebrates John Wiley and sons Inc., London.
17. Joysey K.A. and Kemp T.S. Vertebrate Evolution Oliver and Boyd, Edinberg.
18. Romer A.S. Vertebrate Paleontology University of Chicago Press, Chicago.
19. Newman Phylum Chordata.
20. Goodrich E.S. Structure and development of vertebrates. Dover publications Inc., New York
21. Hard disty M.W. and Potter I.C. Biology of Lampreys Academic Press Newyork
22. T.B.of Zoology Parker and Haswell W.A. Mac millon co. Ltd. London
23. The Biology of Amphibia Noble G.K. Dover Publication Inc Newyork

M.Sc. Part I Semester –II Zoology

Session 2023-24

M.Sc. Part I Semester –II Zoology

Paper-II, Comparative Endocrinology (02MSCZ002)

NEP-2020 (Core DSC) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

1.1 Hormones and functions in Coelentereta and Helminths.

1.2 Neurosecretory system in Annelida: structure, hormones and functions.

1.3 Neuroendocrine system in Mollusca: structure, hormones and functions.

1.4 Hormones and functions in Echinodermata.

Unit-II **(15 Hrs)**

2.1 Neuroendocrine system in crustacean; structure and hormones.

2.2 Endocrine control of metamorphosis, reproduction and colour change mechanisms in crustacea.

2.3 Cephalic neuroendocrine system in insects: structure and hormones.

2.4 Endocrine control of metamorphosis and reproduction in insects.

Unit-III **(15 Hrs)**

3.1 Pineal organ: structure, hormones and functions.

3.2 Hypothalamo hypophysial system: structure, hypothalamic nuclei, hormones and function.

3.3 Pituitary: cell types, hormones and functions.

3.4 Thyroid: Structure, hormones and function.

Unit-IV **(15 Hrs)**

4.1 Parathyroid ultimobranchial glands: Structure, hormones and regulatory mechanisms.

4.2 Gastro-entero-pancreatic endocrine system: endocrine pancreas and gastro intestinal tract: endocrine cells, hormones and functions.

4.3 Adrenal gland: structure, hormones and functions in vertebrates.

4.4 Gonadal hormones in vertebrates and their hormonal actions, feedback mechanisms.

Books Recommended for Comparative Endocrinology

1. General & Comparative Endocrinology: E.J.W., Barrington, Oxford, Clarendon Press.

2. Text Book of Endocrinology: R.H. Williams, W.B. Saunders.

3. Endocrine Physiology: C.R. Martin, Oxford University Press.

4. Comparative Endocrinology: A Gorbman et al, John Wiley & Sons.

5. Medical Physiology: W.F. Ganong (1981): 10th Edn. Lange Medical Publications.

6. Principles of Anatomy and Physiology: Tortora Grabowski, 9th Edn., John Willey & Sons.
7. Reproductive Physiology of Vertebrates: Van Tienhoven, A. (1983): 2nd Edn. Cornell Univ. Press, New York.
8. The Pituitary Gland: Imura, H. (1994), 2nd Edn., Comprehensive Endocrinology Revised Series Raven, New York.
9. Comparative Vertebrate Endocrinology: Bentley, P.J. (1976) Cambridge University Press, Cambridge.
10. General & Comparative Endocrinology: E.J.W., Barrington, Oxford, Clarendon Press.
11. Text Book of Endocrinology: R.H. Williams, W.B. Saunders.
12. Comparative Vertebrate Endocrinomental: Bentely, P.J. (1976) Cambridge University Press, Cambridge.
13. Invertebrate endocrinology: D. B. Tembhare, Himalaya publishing House (2012)

Semester-II, Practical-III, Structure and Function of Vertebrates and Comparative Endocrinology (CREDIT - 2)

Section-A

1 Study of museum specimens using already available specimens in the museum/ charts/ models/ photographs/ digital alternatives etc. Classification of vertebrates up to order and comments on the specimens representing all phyla.

2 Anatomical Observations

Anatomical observations, demonstration and detailed explanation of the following with the help of ICT tools/ models/ charts/ photographs etc.

a) Brain and cranial nerves- Fish/ Rat.
b) Arterial and venous systems- Fish/Rat
c) Urinogenital system- Fish/Rat.
d) Reproductive systems- Fish/Rat.
e) Internal ear in fish, Weberian ossicles in fish, accessory respiratory organs in fish.

3 Mounting: Study of Stained Permanent preparation of scales, ampullae of Lorenzini, otolith, striated muscles and cartilage of fish using animal wastes from local recognized fish markets or with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

4 Microtomy, Histology and Skeleton

a. Fixation, embedding, sectioning and staining of the internal organs of vertebrates
(Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)

b. Study of slides of internal organs of vertebrates with the help of already already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

c. Axial and appendicular skeleton of fowl and rabbit using already available skeleton/ ICT tools/ models/ charts/ photographs etc.

Section-B

1 Microtomy - Fixation, embedding, sectioning and staining of the endocrine gland (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)

2 Histological study –

a) Histological slide of endocrine glands and gonadal endocrine components, EM structure of endocrine gland

b) Identification of pituitary cell type.

c) Identification of α, β, γ, cells of Islets of Langerhans with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

3 **Anatomical Observations- Anatomical observations, demonstration and detailed** explanation of the endocrine glands in a) Cockroach and b) Endocrine glands- pituitary, thyroid parathyroid, adrenal in fish/rat with the help of ICT tools/ models/ charts/ photographs etc.

Distribution of Marks	**Marks**
1. Anatomical observations of fish/rat	10
2. Stained permanent preparation:	05
3. Identification and comment on the spots (1-10)	20
4. Submission of stained permanent slides	05
5. Anatomical observations of Endocrine glands	10
6. Histological staining of endocrine gland	10
7. Class Record	10
8. Viva-voce	10
Total marks	80

M.Sc. Part I Semester –II Zoology

Paper-III, Molecular Biology and Biotechnology (02MSCZ003)

NEP-2020 (Core DSC) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

1.1 Cot ½ and Rot ½ values, organelle genome, DNA structure, forms of DNA.

1.2 DNA replication – molecular mechanisms of prokaryotic and eukaryotic DNA replication, regulation of replication.

1.3 DNA damage and repair – types of DNA damages, excision repair system.

1.4 Mismatch repair, recombination repair, double strand break repair, and transcription Coupled repair.

Unit-II **(15 Hrs)**

2.1 Transcription- prokaryotic and eukaryotic transcription, RNA polymerases, transcriptional unit, initiation, elongation, termination, transcriptional factors.

2.2 Regulation of transcription – Operon, positive and negative control, attenuation phage strategies, anti-termination, response elements and inducible elements.

2.3 Translation - prokaryotic and eukaryotic translation, genetic code, altered code in elongation, termination factors, fidelity of translation, post translational modifications.

2.4 Mobile DNA elements – transposable elements, IS elements, P elements, retroviruses, retrotansposons.

Unit-III **(15 Hrs)**

3.1 Antisense and ribozyme technology – initiation of splicing, polyadenylation, molecular mechanisms of antisense molecules, miRNA, siRNA, gene silencing.

3.2 Isolation and sequencing of DNA, gene amplification, PCR, RAPD, RFLP, MaxamGilbert, Sanger's dideoxy methods.

3.3 Splicing and Cloning – Cloning vectors for recombinant DNA technology- plasmids, cosmids, phagemids, YACS, gene replacement, restriction enzymes.

3.4 Hybridization techniques – Southern- Northern hybridization, microarray.

Unit-IV **(15 Hrs)**

4.1 Medical biotechnology- Application of restriction fragment length polymorphism (RFLP) in forensic science, disease prognosis and genetic counseling.

4.2 Agricultural biotechnology- biofertilizers, bioinsecticides, biogas.

4.3 Immunobiotechnology-Hybridoma technology and monoclonal antibodies.

4.4 Industrial and Environmental biotechnology-microbial production of fermentation products, enzymes, antibiotics, single Cell proteins and biosensors.

Books Recommended for Molecular Biology and Biotechnology

1. Harper's Review of Biochemistry, Prentice Hall.
2. Principles of Biochemistry by Lehninger and Nelson, CBS publications and Distributors.
3. The Biochemistry "Students companion" by Allen J. Scism, Prentice Hall.
4. Fundamentals of Biochemistry by Jain J. L., S. Chand Publication.
5. Principles of Biochemistry by Zubay J. L., WM. C. Brown Publishers.
6. Principles of Biochemistry by Horton, Prentice Hall.
7. Concept of Biochemistry by Boyer R., Coel publication co.
8. Harper's Biochemistry eds.Murray, R. K. P. and Granner, D. K. Prentice Hall.
9. Biochemistry by Mathews C. K. and Van Holde K. E., Benjamin C. publishing Co.
10. Biochemistry by Garrett R. H. and Grisham C. M., Saunders College publication.
11. Cell and Molecular Biology by De Robertis- E. D. P., I. S. E. publication.
12. Molecular Biology by Turner P. C. and Mc Lennan , Viva Books Pvt. Ltd.
13. Advanced Molecular Biology by Twyman R. M., Viva Books Pvt. Ltd.
14. Molecular Biology by Freifelder D., narosa publication House.
15. Gene VI by Benjamin Lewis, Oxford press.
16. Gene VIII by Benjamin Lewis, Oxford press.
17. Molecular biology of Gene by Watson J. D. et. al., Benjamin publication.
18. Molecular cell Biology by Darnell J. Scientific American Books USA.
19. Molecular Biology of the Cell by Alberts B., Bray D. Lewis J., garland publishing Inc.
20. Genetics Vol. I and II by Pawar C. B., Himalaya publication.
21 Essentials of Molecular Biology by Freifelder D., narosa publication House.
22. Molecular Cell Biology by Laodish H., Berk A., Zipursky S. L., Matsudaira P., Baltimore D. and Darnell J., W. H. Freeman and Co.
23. The Cell: Molecular Approch by Cooper G. M.
24. Molecular Biology by Upadhay A and Upadhay K. Himalaya publication.

Semester-II, Practical –IV, Molecular Biology, Biotechnology (CREDIT - 1)

Practical Based on C3 + Any one of Major Elective

Section-A

1. Lab Safety Techniques and sterilization.
2. Isolation of bacterial DNA and estimation by UV spectrophotometry.
3. Isolation of Liver DNA and quantification, Agarose gel electrophoresis of isolated DNA.
4. Isolation of RNA and agarose gel electrophoresis.
5. To analyse protein on native PAGE and SDS-polyacrylamide gel electrophoresis.
6. Demonstration of DNA amplification by PCR

7. Biochemical estimation of sugar: O-toluidine method (Source of blood: Local recognized pathology laboratory)

8. Biochemical estimation of DNA, RNA, Protein, Glycogen and Cholesterol

9. Demonstration of separation of amino acids by paper chromatography and TLC

10. Demonstration of glycogen/ carbohydrate- PAS reaction (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)

11. . Demonstration of DNA: Feulgen's reaction (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)

12. Demonstration of Lipid: Sudan Black B staining (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)

11.

Distribution of Marks	**Marks**
1. Major experiment (2 to 6)	12
2. Minor experiment (7 to 8)	10
4. Minor Experiment (9 to 12)	08
5. Class record	05
6. Viva voce	03
----------	.....
Total marks	40

M.Sc. Part I Semester –II Zoology

Paper-IV, Biology of Parasite (02MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I (Nematoda and Arthropoda) **(15 Hrs)**

1.1 General, Organization, Classification & General Pattern of life cycle of Nematodes (animals, plant parasitic & Entomopathogenic),

1.2 Parasitic Adaptation

1.3 Introductory: Nematology:

1.4 Introduction General Morphology, Economic importance

Unit-II **(15 Hrs)**

2.1 Types of Plant nematodes, Host Range, Biology.

2.2 Family- Strongyloidate: Strongyloides stercorales

2.3 Family - Ancyclostomatidae: Ancylostoma duodenale

2.4 Family- Filaridae: Wuchereria bancrofti

Unit-III **(15 Hrs)**

3.1 Plant Nematode Relationship: Host parasite relationship,

3.2 Mechanism involved in injury & histopathology of infected tissue, Interaction with other microorganism

3.3 Brief Structure. Life Cycle. Epidemiology. Pathogenicity and Control of Root knot and Cyst Nematodes.

3.4 Acanthocephala - General Organization and Classification

Unit-IV **(15 Hrs)**

4.1 Medically Important Insects : Arthropods and sectors of human diseases (mosquitoes, lice, flies and ticks)

4.2 Mode of transmission of pathogens by vectors.

4.3 Chemical, biological and environmental control of anthropoid vectors

4.4 Insects carrying Vesication. Urtricatino and Venomenization

Suggested readings:

1. Handbook of Parasitology by AK Awasthi and BD Patnaik. Publisher : Dominant Publishers & Distributors, India
2. Veterinary Parasitology by MA Taylor and R. L. Coop & RL Wall. Publisher : John Wiley & Sons, USA
3. Modern Parasitology: A Textbook of Parasitology by FEG Cox. Publisher : John Wiley & Sons, USA
4. Arthropod Born Diseases by Carlos Brisola Marcondes (ed.). Publisher : Springer
5. Tylenchida: Parasites of Plants and Insects by Mohammad Rafiq Siddiqi. Publisher : CABI Publishing, UK
6. Imm's General Textbook of Entomology by OW Richard & RG Davies. Publisher : Chapman & Hall, London
7. An Ecological Approach to Acanthocephalan Physiology by DWT Crompton. Publisher : Cambridge University Press
8. Nematode Parasites of Domestic Animals and man by Norman D Levine. Publisher : Burgess Publishing Co., London
9. Plant Nematology: , 2nd Edition by Roland N Perry, Maurice Moens. Publisher: CABI
10. Entomopathogenic Nematology by Randy Gaugler. Publisher: CABI

PRACTICALS ON BIOLOGY OF PARASITES:

1. Techniques in Nematology: Methods of sampling (soil & plant samples), Methods of extracting nematodes from soil & plant samples, Methods of processing nematodes for observation.

2. Study of prepared slides and museum specimens of selected parasites of representative groups of helminths and arthropods.

3. Study of life cycle, role as vector & control measures of: Ticks (Argas, Boophilus)

Mosquito - anyone from- Anopheles/ Aedes/ Culex

Any two flies: Tabanus/ Phlebotomus/ Sarcophaga. Cyclops

4. Ectoparasites & Endoparasites of wild rat, cattle, dog, chick & human including stages in excreta.

2. Preparation and submission of slides or specimens of parasites obtained from your local areas.

Marks Distribution for Practical:

1. Major Experiment	12
2. Minor Experiment	08
3. Spotting (1-10)	10
4. Class record	07
5. Viva-Voce	03
……	
Total Marks	**40**

M.Sc. Part I Semester –II Zoology
Paper-V, Aquaculture and management (02MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

1.1 Present status and scope of Aquaculture - Global and National scenario.

1.2 Planning and construction of fresh water fish farm.

1.3 Major cultivable species for aquaculture: freshwater, brackish water and marine.

1.4 Traditional, extensive, semi-intensive and intensive cultures of fish and Prawns

Unit-II **(15 Hrs)**

2.1 Functional classification of ponds- head pond, hatchery, nursery, rearing and stocking pond. Carrying capacity of pond.

2.2 Mechanism of liming, fertilizing and manuring of culture ponds

2.3 Physical, chemical and biological control of Weeds and algal blooms.

2.4 Physio-chemical conditions of soil and pond water for culture

Unit-III **(15 Hrs)**

3.1. Induced breeding of major carps for blue revolution and operation of Chinese Hatchery.

3.2. Culture of Indian major carps (IMC): Pre-stocking management (Dewatering, drying, ploughing/desilting; Eradication of predators, weeds and algal blooms, liming and fertilization)

3.3. Culture of Indian major carps- Post-stocking management (Feeding and Harvesting).

3.4. Fish diseases and their control: Protozoa, nematode, arthropod, fungal, bacterial and viral.

Unit-IV **(15 Hrs)**

4.1 *Macrobrachium rosenbergii*- Morphology, seed production, culture and management.

4.2. Pearl Culture and Crab culture.

4.3 Integrated fish farming

4.4 Composite fish culture

Books recommended

1. Aquaculture principles and practices by Pillay
2. Aquaculture and fisheries by Dunham
3. Text book of Aquaculture by CBL Shrivastav
4. Fish and fisheries of India by V.G. Jhingran by Hindusthan Publishing Compony.

5. Fish Biology by CBL Shrivastav
6. Text book of Fish biology and fisheries by S.S.Khanna and H.R. Singh

Practical's for Aquaculture and Management:

1. Identification of Indian Major carp and minor carp
2. Identification of Exotic carp, mud carp, grass carp, mirror carp, silver carp.
3. Study of gut content of Herbivorous and carnivorous fishes.
4. Study of fishes and Prawns available in local market and their identification.
5. Study of Aquatic plants-marginal, floating submerged, merged
6. Study of disease causing organisms: Protozoa ,Nematodes and Arthropods
7. Study of Phyto and Zoo plankton
8. Study of benthic fauna of freshwater bodies
9. Study of natural fish food
10. Preparation of artificial fish food
11. Soil analysis:
12. Study of Physical parameter of pond water (Temp., turbidity, Light ,Conductivity, Transparency)
13. Study of Chemical Parameter of Pond water (Dissolved Oxygen, Free Carbon dioxide, pH, Alkalinity, Biological Oxygen Demand, Chemical Oxygen Demand, Total Dissolved Solide, Hardness,Sulphate,calsium,Magnesium)
14. Field Visit - Visit to Fresh water fish farm or CIFA

Marks Distribution for Practical:

1. Major Experiment	10
2. Minor Experiment	05
3. Spotting (1-10)	10
4. Class record	05
5. Submission of Field visit Diary and slides	07
6. Viva-Voce	03
…….....	
Total Marks	**40**

M.Sc. Part I Semester –II Zoology

Paper-VI, Applied Entomology (02MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I Agricultural Entomology- (15 Hrs)

1.1 Concept of insect pest; Economic Injury Level (EIL), Economic Threshold Level (ETL), Dynamics of EIL;

1.2 Pests of major crops (Life cycle, Nature of damage and control measures): Pests of Paddy,

1.3 Insect Pest control: Chemical, Mechanical, Cultural and Biological control measures; Integrated Pest Management (IPM)

1.4 Study of appliances used in pest control: Dusters; Sprayers- categories of sprayers, agricultural Aircrafts; Granule applicator; soil injectors.

Unit- Sericulture- (15 Hrs)

2.1 Types of Silk Moths with special reference to their scientific name, geographical distribution, and host plants.

2.2 Life cycle of Bombyx mori; Structure of Silk Gland; Voltinism, Rearing of mulberry silkworm. Reeling and extraction of silk; Mulberry cocoon management.

2.3 Mulberry plant types and cultivation; Common diseases and pests of mulberry silkworm and their control measures.

2.4 Prospects of Sericulture in Maharashtra; employment potential in sericulture.

Unit-III Apiculture- (15 Hrs)

3.1 Various domesticated species of Honeybee. Social organization and life cycle of Honeybee.

3.2 Modern method of Beekeeping: Newton Box and Langstroth Box.

3.3 Extraction of honey and composition of honey. Pests, Parasites and Diseases and their control measures.

3.4 Bee-economy: Apiculture products and their uses.

Unit-IV Lac culture- (15 Hrs)

4.1 Lac insect and its life history, Propagation of lac insects.

4.2 Lac host and crop management technology and processing of lac.

4.3 Lac insect- natural enemies and their management.

4.4 Products and bye-products of lac.

Books Recommended for Applied Entomology

1. A text book of Applied Entomology, vol.2 - K. P. Srivastava, 1996.
2. Modern Entomology. D. B. Tembhare 2013.
3. Sericulture and Pest Management – T.V. Sathe and A.D. Jadhav, 2001.
4. Introduction to General and applied entomology. V. B. Awasthi.2017
5. Agricultural Pests of India and South East Asia – A.S. Atwal, 1993.
6. Beekeeping in the tropics – G.S. Smith, 1960.
7. Beekeeping in India, ICAR, New Delhi, S. Singh, 1975.
8. Lac culture in India farm information unit, DEMOFA, New Delhi, S. Krishnaswami,
9. Elements of Entomology- Rajendrasingh.2004

Practical

1. Methods of collection, preservation, and identification of economically important insects.
2. Identification of insect pests (Order, family and specimen characters only):
3. Morphological studies of various castes of Apis sp.
4. Identification of life stages of Bombyx mori; Identification of Bivoltine and multivoltine mulberry cocoon.
5. Identification and medical significance of following insects (adults) through permanent slides/photographs: Aedes sp., Culex sp., Anopheles sp. [for mosquito, larvae and both sexes of adults], Musca sp., Phlebotomus sp., Cimex sp., Pediculus humanuscapitis., Xenopsylla sp.
6. Visits to any one place of applied entomological significance (submission of a field report):
7. Agricultural field/ forest for on spot study of pests and damage caused.
8. Any Sericulture/Lac culture farm for studying grainage and rearing activities
9. Visit to an apiary to study various activities o Apiculture
10. Any rural or urban health centre to study various aspects of vector surveillance

Marks Distribution for Practical:

1. Spotting (1-10)	20
2. Class record	10
3. Submission of Field visit Diary and slides	07
4. Viva-Voce	03
Total Marks	**40**

M.Sc. Part I Semester –II Zoology

Paper-VII, General and Applied Ichthyology (02MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I **(15 Hrs)**

1.1 General characters and outline classification of superclass Pisces.

1.2 Classification and general characters of Elasmobranchs/ Chondrichthyes:-Sharks and Rays. Holocephali

1.3 Classification and general characters of Actinopterygii /Ray finned fishes

1.4 Classification and general characters of Dipnoi (lung fishes) with specialized characters.

Unit-II **(15 Hrs)**

2.1 Organs of Respiration in fishes

2.2 Types and structure of gills. Mechanism of Respiration

2.3 Accessory respiratory organs in fishes

2.4 Air bladder: Origin, Development , types of air bladder, functions.

Unit-III **(15 Hrs)**

3.1 Fresh water fisheries in India, Riverine and Reservoir fisheries

3.2 Eustarine and Marine fisheries in India.

3.3 Breeding of Indian Major Carps: Natural Breeding, Induced breeding, Methods of obtaining eggs, spawn, fry and fingerlings from Natural resources.

3.4 Food and feeding habits of cultivable fishes Nutritional requirements of fishes.

Unit-IV **(15 Hrs)**

4.1 Construction and Maintenance of fish farm.
Pond management: Water, Soil, Manuring and liming

4.2 Different fishing methods and types of fishing gears.

4.3 Concept of composite fish farming and polyculture

4.4 fish pathology: Different fish pathogens, Viral, Beacterial, Fungal and Parasitic. Prophylactic measures.

Books Recommended for General and Applied Ichthyology

1. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Jayaram, K.C (1981): Zoological Survey of India, Calcutta.

2. Ichthyology : Lagler, K. F., Bardach, J. and Miller, R. (1977) John Wileys and sons.

3. An aid to the identification of common commercial fishes of India and Pakistan: Mishra K.S. (1982)

4 Aquaculture: The farming and Husbandry of freshwater and marine organism: Bardach, J.E. (1974) . Narendar Publication House, New Delhi.

5. Fish and fisheries of India: Jhingran , V.G.(1985) Hindustan Publication Company, New Delhi.

6. An introduction to fishes: S.S. Khanna Central Book Depot, Allahabad.

7. General and Applied Ichthyology (fish and fisheries) S.K. Gupta, P.C. Gupta. S. Chand Publication

Practicals

1. Identification and classification of fresh water and marine fishes with the help of already preserved specimens/ ICT tools/Charts/Models/ Photographs.
2. Study of accessory respiratory organs in fishes with the help of ICT tools/ Charts/Model's/Photographs.
3. Permanent preparation of various types of scales in fishes.
4. Identification of various stages of fry and fingerlings of major carps.
5. Estimation of dissolved oxygen in water sample.
6. Estimation of free CO_2 in water.
7. Estimation of chloride in water sample .
8. To study the rate of oxygen consumption in fishes.
9. Study of fish diseases with the help of slides (if already available) /ICT Tools/ photographs .
10. Visit to fish farm.

Distribution of Marks:-

1. Identification of spots (A to J) 20
2. Estimation of water sample 08
5. Class record and submission of visit diary ---------- 08
6. Viva 04

==========

Total Marks: 40

M.Sc. Part I Semester –II Zoology
Paper-VIII, Economic Zoology (02MSCZ004)

NEP-2020 (Major Elective) Credits-3 Marks - 80

Unit-I Live Stock Management: (15 Hrs)

1.1 Dairy: Introduction to common dairy animals and techniques of dairy management

1.2 Types, loose housing system and conventional barn system; advantages and limitations of dairy farming

1.3 Establishment of dairy farm and choosing suitable dairy animals-cattle Cattle feeds, milk and milk products, Cattle diseases

1.4 Poultry: Types of breeds and their rearing methods, Feed formulations for chicks, Nutritive value of egg and meat , Disease of poultry and control measures

Unit-II Aquaculture: (15 Hrs)

2.1 Aquaculture in India: An overview and present status and scope of aquaculture

2.2Types of aquaculture: Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture

2.3 Prawn culture: Culture of fresh and marine water prawns. Preparation of farm.

2.4 Preservation and processing of prawn, export of prawn.

Unit-III Fish culture: (15 Hrs)

3.1 Common fishes used for culture.Fishing crafts and gears.

3.2 Ornamental fish culture: Fresh water ornamental fishes- biology, breeding techniques

3.3 Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality.

3.4 Modern techniques of fish seed production. Control of snail and algal growth.

Unit-IV Vermiculture: (15 Hrs)

4.1 Scope of vermiculture. Types of earthworms.

4.2 Habit categories - epigeic, endogeic and anecic; indigenous and exotic species.

4.3 Methodology of vermicomposting: containers for culturing, raw materials required, preparation of bed, environmental pre-requisites, feeding, harvesting and storage of vermicompost.

4.4 Advantages of vermin composting. Diseases and pests of earthworms

Books Recommended for Economic Zoology

1. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling.
3. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk
5. Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.
7. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
8. YadavManju (2003). Economic Zoology, Discovery Publishing House.
9. JabdePradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
10. Cherian &Ramachandran Bee keeping in-South Indian Govt. Press, Madras.
11. Sathe, T.V. Vermiculture and Organic farming.
12. Bard. J (1986). Handbook of Tropical Aquaculture.
13. Santhanam, R. A. Manual of Aquaculture.
14. Zuka. R.1 and Hamiyn (1971). Aquarium fishes and plants
15. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.
16. Animal Disease- Bairagi K. N. Anmol Publications Pvt.Ltd 2014
17. Economics Of Aquaculture - Singh(R.K.P) - Danika Publishing Company 2003
18. Applied and Economic Zoology (SWAYAM) web https://swayam.gov.in/nd2_cec2 0_ge23/preview

Practicals for Aquaculture and Management:

1. Types of Dairy cows: Indigenous- Gir, Red Sindhi, Sahiwal, Deoni, Hallikar, Amritmahal, Khillari, Kangayam, Bargur, Umbalchery, Pullikulam/Alambadi, Bachaur, Dagri, Himachali Pahari, Kenkatha,Kherigarh, Konkan Kapila, Ladakhi, Mewati, Motu, Sir
2. Identification of Indian Major carp and minor carp
3. Identification of Exotic carp, mud carp, grass carp, mirror carp, silver carp.
4. Identification of Aquarium fishes Study of gut content of Herbivorous and carnivorous fishes.
5. Study of fishes and Prawns available in local market and their identification.
6. Study of Aquatic plants-marginal, floating submerged, merged
7. Study of disease causing organisms: Protozoa ,Nematodes and Arthropods

8. Qualitative analysis of Zooplankton and Phytoplankton
9. Quantitative analysis of Zooplankton and Phytoplankton
10. Study of benthic fauna of freshwater bodies
11. Study of natural fish food
12. Preparation of artificial fish food
13. Types of earthworm
14. Preparation of Vermicomposte and vermiwash

13. Field Visit - Visit to Fresh water fish farm or CIFA

Marks Distribution for Practical:

1. Major Experiment (Qualitative/Quantitative analysis of Plankton)	10
2. Minor Experiment (10 to 12)	05
3. Identification of Spotting (A to J)	10
4. Class record	05
5. Submission of Field visit Diary and slides	07
6. Viva-Voce	03
…….....	
Total Marks	**40**