

KASHI NARESH UNIVERSITY, BHADOHI

DEPARTMENT OF ZOOLOGY

(National Education Policy-2020)

Syllabus

of

ZOOLOGY

(Effective from Academic Session 2026-2027)

For

M.Sc.

Approved by

**Board of Studies
Department of Zoology
Faculty of Science
Kashi Naresh University
Bhadohi**



Convenor Head
Department of Zoology
Kashi Naresh University, Bhadohi



Dean
Faculty of Science
Kashi Naresh University, Bhadohi



(Prof. Laxmi Yadav)
Member of Board of Studies



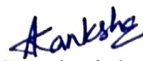
(Dr. Prakash Chandra Gupta)
Member of Board of Studies



(Dr. Asutosh K. Srivastav)
Member of Board of Studies



(Dr. Rustam Ali)
Member of Board of Studies



(Dr. Akanksha Kushwaha)
Member of Board of Studies

Course Name: Master of Science in Zoology - Total Credits – 80

Semester Courses of M. Sc. Zoology based on CBCS

The course of M. Sc. Zoology will be spread in two years previous and final. Each year will have two semester examinations and thus there will be total four semester examinations.

PROGRAMME STRUCTURE

The M.Sc. Programme is divided into two parts as under. Each part will consist of two semesters as given below:

First year – semester 1 and semester 2

Second year- semester 3 and semester 4

Each first and second semester would consist of four papers (course) and one practical course (four credits for each paper). Semesters III would have two compulsory papers and one special paper (to be selected any one from **MSZ 303A**, **MSZ 303B**, **MSZ 303C**) and the fourth paper will be practical paper divided in two parts: **MSZ304A** (General) and **MSZ304B** (Special) both carrying 4 Credits. Semester IV would comprise of one compulsory paper and two optional papers (**MSZ 402A**, **MSZ 402B**, **MSZ 402C**, **MSZ 403A**, **MSZ 403B**, **MSZ 403C**) from which each student would have to select one and the fourth paper will be practical paper divided in two parts: **MSZ 404A** (General) and **MSZ 404B** (Special) both carrying 4 credits. It is mandatory for each student to complete a dissertation/research project, assigned in semester III semester IV and will carry 4 credits each. It would be theoretical or laboratory or both components.

M. Sc. Previous (w.e.f. 2026-27)

FIRST SEMESTER			
PAPER CODE	NAME OF PAPER	MARKS	CREDIT
MSZ 101	Non-Chordata	100(75+25)	4
MSZ 102	Environmental Biology	100(75+25)	4
MSZ 103	Animal Physiology and Immunology	100(75+25)	4
MSZ 104	Biochemistry	100(75+25)	4
MSZ 105	Practical	100(75+25)	4
	Total	500	20
SECOND SEMESTER			
PAPER CODE	NAME OF PAPER	MARKS	CREDIT
MSZ 201	Chordata	100(75+25)	4
MSZ 202	Biosystematics, Evolution and Animal Behavior	100(75+25)	4
MSZ 203	Developmental Biology and Endocrinology	100(75+25)	4
MSZ 204	Economic Zoology	100(75+25)	4
MSZ 205	Practical	100(75+25)	4
	Total	500	20



M.Sc. Final (w.e.f. 2027-2028)**THIRD SEMESTER**

PAPER CODE	NAME OF PAPER	MARKS	CREDIT
MSZ 301	Cytology and Genetics	100(75+25)	4
MSZ 302	Biostatistics, Bioinformatics and Bioinstrumentation	100(75+25)	4
MSZ 303	Special [select any one]		
	MSZ 303A Fish Biology–Taxonomy and Morphology MSZ 303B Entomology– Morphology, Physiology, Development and Ecology MSZ 303C Cell Biology –Cytological Techniques	100(75+25)	4
MSZ 304	Practical MSZ 304A General and MSZ 304B Special	100(75+25)	4
MSZ 305	Research Project*/only literature survey	100	4
	Total	500	20

FOURTH SEMESTER

PAPER CODE	NAME OF PAPER	MARKS	CREDIT
MSZ401	Molecular Biology	100(75+25)	4
MSZ402	Special Paper I [select any one] MSZ402A Fish Biology-Applied Ichthyology and Development MSZ402B Entomology – Evolution and taxonomy MSZ402C Cell Biology – Cell structure and function	100(75+25)	4
MSZ403	Special Paper II [select any one] MSZ403A Fish–Physiology and Ecology MSZ403B Entomology – Economic Entomology MSZ403C Cell Biology–Cell Regulation and Principles of Biotechnology	100(75+25)	4
MSZ404 AND	Practical MSZ404A General and MSZ404B Special	100(75+25)	4
MSZ405	Research Project/Dissertation*	100	4
	Total	500	20

*Research project will be evaluated at the end of 3rd and 4th semester out of 8 (4+4) credit.

Total Credits = 40 + 40 = 80 (Year 1 + 2)

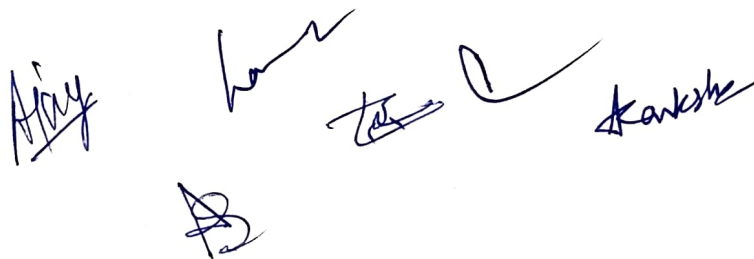
Total Marks = 2000 (Semester 1 + 2 + 3 + 4)

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Programme Specific Outcomes of Zoology

1. Developing better understanding of concepts of biology at biochemical, molecular and cellular level, physiology and reproduction studying them at organism level, and ecological impact on animal behavior.
2. Developing the advance level of statistical knowledge which helps in data handling and practical assessments. There is extensive study of instruments so that the students can handle them with ease for further research work.
3. Developing the concept of animal adaptation by exploring the diversity of functional characteristics of various kinds of organisms which is closely related to evolutionary processes and environmental changes.
4. Understanding of Mendel's principle of heredity, its extension and chromosomal basis; chromosomal anomalies and associated diseases; developing concepts of regulation of gene activity in prokaryotes and eukaryotes of transcriptional and post transcriptional level.
5. Study of environment is focused with the aim to make students aware of the structure and function of environment and the climate change, adaptations and losses due to it.
6. Development of an understanding of animal science for its application in entomology, apiculture, aquaculture, agriculture and modern medicine.
7. Detailed acquaintance of developmental biology correlating it to the evolution. Elucidation of early embryonic development and organogenesis of invertebrates and vertebrates, explanation of embryonic stem cells and their application.
8. To understand animal physiology in detail and a comparative outlook between non vertebrates and vertebrate physiology.
9. Development of theoretical and practical knowledge in handling the animals and using them as model organism.
10. Each semester having a departmental seminar in order to make students aware of the research paper writing and presentation
11. To understand the impact of chemicals on biodiversity of microbes, animals and plants; Bioindicators and biomarkers of environmental health. Biodegradation and bioremediation of chemicals; competition and existence; intraspecific and interspecific interactions.
12. Dissertation work is incorporated as theoretical/practical project work with the aim to inculcate the ability to develop a research question, organize relevant available literature and development of technical writing skill.



TWO-YEAR FULL-TIME PROGRAMME IN MASTER OF SCIENCE (ZOOLOGY)

Affiliation

The proposed programme shall be governed by the Department of Zoology, Faculty of Science, Kashi Naresh University Bhadohi.

Syllabus for M.Sc. (Zoology)

Semester I

Paper I: MSZ 101–Non-chordata

Unit 1 – Protozoa, Porifera and Coelenterata

Protozoa-Locomotion- locomotory organelles and methods of locomotion, Nutrition- Holozoic, Holophytic, Saprozoic and Myxotrophic nutrition, Reproduction- Asexual and sexual, Protozoa and soil fertility, Protozoa and Diseases

Porifera-Skeleton-Spicules and spongin fibers, Canal System-Types and functions of canal system, economic importance of poriferans

Coelenterata-Origin of Metazoa, Polymorphism- Basic forms and patterns, Importance of polymorphism, Corals-coral polyp, coral skeleton, types of corals, coral reefs. General organization and affinities of Ctenophora

Unit 2- Platyhelminthes and Aschehelminthes

Parasitism in Platyhelminthes and Aschehelminthes, Parasitic adaptations in Trematodes and Cestodes-Morphological and physiological adaptations, larval stages of Trematoda and Cestoda, Phytionematodes, Economic importance of Helminths.

Unit 3 - Annelida and Arthropoda

Segmental organs, Filter feeding, Coelom and Metamerism, Larval forms of crustacean, Parasitism in crustacea, Respiration in Arthropods, General organization in Onychophora, Economic importance of Arthropoda

Unit 4- Mollusca and Echinodermata

Respiration in Mollusca, Torsion in Gastropods, Water vascular system and Larval forms in Echinodermata.

Suggested readings

1. Barnes *et al* (2009). The Invertebrates: A synthesis. Wiley Backwell
2. Hunter: Life of Invertebrates (1979, Collier Macmillan)
3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan) 19
4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
5. Brusca and Brusca (2016) Invertebrates, Sinauer
6. Jan Pechenik (2014) Biology of the invertebrates, McGraw Hill
7. Kotpal R. L. (2025) Modern textbook of Invertebrates

Paper II: MSZ 102-Environmental Biology

Unit1- Population Ecology

Characteristics of Population, Population size and exponential growth, Population dynamics, Competition, Population Interactions

Unit 2- Ecosystem

Nature of Ecosystem, Ecosystem services, Productivity, Food webs and Energy flow through ecosystems, Biogeochemical cycles, Types of niche and Biomes

Unit 3- Environment

Environmental stress, Global warming, Acid Rain, Environmental toxicants-their uptake and bioaccumulation and biotransformation (Ecotoxicology), Xenobiotics, Bio-indicators and Biomarkers

Unit 4- Biodiversity and Conservation

Levels of Biodiversity, Indian Biodiversity & Its Distribution; Significance; Threats to biodiversity; IUCN categories of threat; Ex-situ and in-situ conservation strategies; International and national conservation policies and legislation, Biodiversity Hotspots: Keystone species, Indicator Species

Suggested Readings

1. Biodiversity and Ecosystem functioning. edited by Michel Loreau, Shahid Naureen and Pablo Inchausti (Oxford University Press.)
2. Biodiversity and Conservation in Forests. By Diana. F. Tomback. Publication MDPI Multidisciplinary Digital Publishing Institute.
3. Fundamental Processes in Ecology: An Earth system Approach. 2007. Wilkinson, D.M. Oxford University Press, UK.
4. Essentials of Ecology. G.T. Miller, Jr. & Scott. E. Spoolman, 2014, Brooks/Cole, Cengage Learning.
5. Fundamentals of Ecology. E.P. Odum & Gray. W. Barrett, 1971, Saunders.
6. Handbook of Population 2005, Dudley L. Poston, Michael Micklin. Springer
7. Ecology and Environmental Science. By Prof. H. R. Singh and Neeraj Kumar, 8th Edition, 2014

Paper III: MSZ103-Animal Physiology and Immunology

Unit 1- Digestion and Excretion

Physiology of Digestion- Digestion and Absorption of Proteins, Carbohydrates and lipids

Physiology of Excretion- Excretory products, Biosynthesis of Urea, Structure and functional mechanism of nephron

Unit 2- Circulation and Respiration

Physiology of Circulation- Patterns of Circulation among mammals, Physiological categories of Heart, Haemodynamics

Physiology of Respiration- Gaseous exchange in terrestrial and aquatic animals, Respiratory pigments

Unit 3- Nerve Conduction and muscle contraction

Physiology of nerve conduction-Resting and action potential, Synaptic transmission



Physiology of Muscle Contraction- Structure and Mechanism of Contraction of skeletal muscles

Unit 4-Immunology

Structure and functions of MHC (MHC I & MHC II); endogenous and exogenous pathways of antigen processing and presentation, humoral and cell- mediated immune responses, hypersensitivity and autoimmunity, generation of antibody diversity, hybridoma technology

Suggested readings

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
3. Christopher D. Moyes, Patricia M. Schulte 2016 Principles of Animal Physiology. 3rd Edition. Pearson Education
4. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, 2004.
5. Chatterjee C C (2016) Human Physiology Volume 1 & 2. 11th edition. CBS Publishers
6. Kuby Immunology: Jenni Punt *et. al.* 8th Edition (2018)
7. Immunology Introductory Textbook by Nandini Shetty (2025), New Age International Publishers.

Paper IV: MSZ 104–Biochemistry

Unit 1- Bioenergetics

Elementary thermodynamics- First law and second law of thermodynamics. Cell as an open thermodynamic system. Calculation of free energy change during biological oxidation-reduction reactions

Unit 2 - Carbohydrates and lipids

Structure, general properties and biological significance. Metabolic pathways- Glycogenesis and Glycogenolysis. HMP shunt, Oxidative phosphorylation. Beta oxidation of fatty acids

Unit 3- Amino Acids and proteins

Structure, properties and metabolism, Ramachandran plot, protein isolation, solubilities and protein targeting

Classification and significance of Vitamins

Unit 4- Enzymes

Kinetics, inhibition, mechanism of action, Michaelis and Menton equation, Allosteric enzymes, isoenzymes, Ribozymes, Abzymes.

Suggested readings

1. Nelson & Cox Lehningers Principles of Biochemistry McMillan 2000
2. Zubay et al Principles of Biochemistry WCB 1995



3. Voet & Voet Biochemistry Vols 1 & 2 Wiley 2004
4. Murray et al Harper's Illustrated Biochemistry McGraw Hill 2003
5. Wilson and Walker Practical Biochemistry – Principles and Techniques Cambridge University Press
6. Fundamentals of Biochemistry By J. L. Jain *et. al.* Publisher S. Chand.

MSZ 105- Practical

Practical Examination particulars

Labeling of Dissected animal figures (one lower and one higher non-chordate)-05+05=10

Preparation- 05

Spotting (10)–20

Animal physiology exercise-10

Biochemistry exercise- 10

Environmental biology exercise-10

Class record, collection and viva - 10

TOTAL 75

Major Dissections Labeling: Labeling of dissected circulatory system and reproductive system of earthworm. Reproductive and Nervous system of Unio, Pila, Prawn, Sepia and other available non-chordates.

Preparations: Slide preparation of Euglena and Paramecium, sponge gemmules, Obelia colony, Nereis parapodia, Hastate palate of Prawn, salivary glands of Cockroach, mouth parts of other insects.

Museum study: General survey and classification of lower non-chordates

Protozoa- Prepared slides of Paramecium (conjugation and binary fission), Euglena, Vorticella, Ceratium, Noctiluca.

Porifera-Museums of *Euplectella*, *Spongilla*, *Euspongia* Prepared slides of T.S. Sycon, L.S. Sycon, Spicules of sponges.

Coelenterata-Museums of *Physalia Corralium*, *Madrepora*, *Fungia*, *Pennatula*, *Metridium*, *Vellela*, *Porpita*, *Tubipora*, *Gorgonia*, Prepared slides of *Hydra*, *Obelia*

Helminths- Museums of *Taenia solium*, Cysticercus larva of *Taenia solium*, *Schistosoma*, *Ascaris* male, *Ascaris* female, *Ancylostoma*

Annelida-*Nereis*, *Heteroneries*, *Aphrodite*, *Chaetopterus*, *Arenicola*, *Terebella*, *Pheretima*, *Eutyphoeus*, *Dero*, *Branchellion*, *Bonellia*, *Sipunculus* and other available museums

Arthropoda- Museums and slides of major representatives of different classes of phylum Arthropoda

Mollusca-Museums and slides of major representatives of Mollusca

Echinodermata-Museum and slides of major representatives of Echinodermata.

Prepared slides–Miracidium larva, Redia larva, Cercaria larva, Scolex of *Taenia solium*, Mature proglottid and gravid proglottid of *T. solium*, T.S of Mature proglottid and gravid proglottid of *T. solium*, T.S. through body of male *Ascaris*, T.S. through body of female *Ascaris*, T.S. *Nereis* through body segments, Parapodium of *Nereis* etc.

Physiology exercise- Total counts of erythrocytes, total leucocyte counts and differential leucocyte counts of fish, frog, bird and rat Estimation of hemoglobin content in fish, frog, bird and rat Rate of Oxygen consumption of aquatic animals and effects of different stresses upon it Determination of respiratory quotient of an air breathing animal Study of functional properties of the cardiac muscles of frog using acetylcholine and adrenalin

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Biochemistry exercise- Determination of glycogen in animal tissues. Kinetic assay of salivary amylase and study of the effects of time and temperature on urease activity.

Environmental Biology exercise- Study of different structural adaptations to ecological conditions. Study of micro and macro fauna of soil by froth-floatation method, Comparative study of physico-chemical eco-factors in different localities- temperature, pH Estimation of CO₂, O₂, carbonate in freshwater; Study of plankton in a water body; Study of biological effects of certain pollutants.

Semester-II

Paper I: MSZ 201- Chordata

Unit 1

Origin of Chordates; Origin of Agnatha and Gnathostomes; Pisces: Ostracoderms and Devonian (the age of fishes);

Unit 2

Dipnoi (Lung fishes) and their peculiar features; Amphibia: Origin of Tetrapoda

Unit 3

Origin and Evolution of Reptiles. Mesozoic reptiles, Extinct reptiles, Origin of birds, Flightless birds, Flight adaptations.

Unit 4

Mammals: Origin and evolution of Mammals; Characteristic features of Monotremes, Marsupials and Placentals; Aquatic mammals.

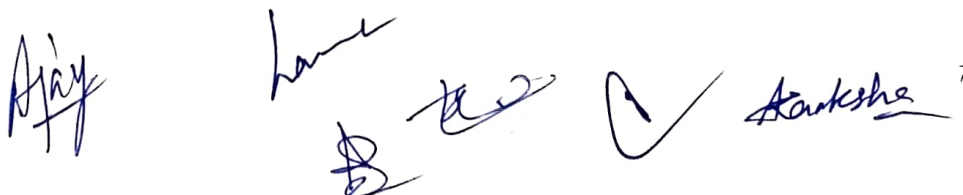
Suggested Readings

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
5. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)

Paper II: MSZ 202- Biosystematics, Evolution and Animal Behaviour

Unit-I

Definition and basic concepts of biosystematics and Taxonomy and its applications in biology; Taxonomic terms: phenon, taxon and category; α , β and γ taxonomy; trends in biosystematics: concepts of different conventional and newer aspects – chemotaxonomy, cytotoxonomy, ethotaxonomy, molecular taxonomy and numerical taxonomy. Speciation, type of lineage changes; Code of Zoological Nomenclature (ICZN), its operative principles; history of rules of Zoological nomenclature

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Unit-2

Reflexes and complex behavior; orientation; Fixed action pattern (FAP); mechanism, deprivation experiment, controversies; FAP characteristic and evolutionary feature; learning and instincts, conditioning, habituation, sensitization.

Unit-3

Innate releasing mechanism; key stimuli, stimulus filtering; Homeostasis and behavior; motivational system, physiological basis of motivation; Hormones and pheromones influencing animal behavior; Aggression; Altruism; Communication; Navigation.

Unit-4 Study of Fossils: types and significance; Theories of Evolution: Synthetic theory of Evolution; Zoogeography and Evolution; Mechanisms of evolution - Natural selection, genetic drift, gene flow, and mutation; Adaptive radiation and convergent evolution; Coevolution and evolutionary arms races; Human evolution.

Suggested Readings:

1. Biology Systematics by A. Mielli, Chapmon and Hall
2. Evolution by Hall and Hallgrimsson, Johnsn and Bartlett publisher
3. Evolution by mark ridley. Blackwell science
4. Evolution by Bartonn. H Briggs, D.E.G., Eisen J.A., Goldstein, A.E. Ptel, N.H., cold spring Harbor Laboratory press NewYork , U.S.A.
5. Methods and principle of systematic Zoology by E. Mayer, E.G. Linsley, R.L. vsinger, McGraw –Hill book
6. Manning, A. An Introduction of Animal Behaviour.
7. Concepts of Animal Behaviour by Reena Mathur
8. Mc Farland, D. Animal Behaviour: Psychology, Ethology & Evolution.
9. Alcock, J. Animal Behaviour: An evolutionary approach.
10. Theory and Practice of Animal Taxonomy and Biodiversity by VC Kapoor.
11. Strickberger's Evolution by Brian K. Hall and Benedikt Hallgrimsson.
12. Organic Evolution (Evolutionary Biology) by Veer Bala Rastogi.

Paper III: MSZ 203- Developmental Biology and Endocrinology

Unit 1- Gonads and Gametogenesis

(i) Sex differentiation in vertebrates (ii) Comparative account of differentiation of gonads in mammals, (iii) Spermatogenesis in vertebrates (iv) Endocrinology of ovary, oogenesis and vitellogenesis in vertebrates, superovulation.

Unit 2- Fertilization, Embryogenesis and Organogenesis

(i) Mechanism of Fertilization: in vivo and in vitro, (ii) Patterns of Cleavage (iii) Patterns of Gastrulation in frog and chick (iv) Development of Brain in vertebrates

Unit 3

(i) Hormones and Reproduction-Seasonal and continuous breeders (ii) Differentiation of cells during embryonic development (iii) Mechanism of Induction during Organogenesis, Primary organizers

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Unit 4

Hormones as messengers and their types, Structure and functioning of Pituitary, Pancreas, Adrenal Glands. Structure and function of Thyroid, Parathyroid, and Gonads; Nature and action of peptide and steroid hormones; Catecholamines; Biosynthesis and secretion of Hormones.

Suggested readings:

1. William's Text Book of Endocrinology: Shlomo Melmed, Kenneth S. Polonsky, P.Reed Larsen
2. Guyton's text book of Medical Physiology
3. A survey of embryology by F.G. Gilchirst, McGraw –Hill Bokk company
4. An introduction to embryology by B.I. Balinsky, CBS college publishing
5. An introduction to embryology by B.L. Balinsky; Dr. Biol. Sci , sunders college publishing
6. Analysis of Biological development by Kalthoff, McGraw –hill science , New Delhi, India.
7. Developmental bology by Gilbert, Sinauer Associates Inc, Massachusetts, USA

Paper IV: MSZ 204–Economic Zoology

Unit 1- Aquaculture

Marine, riverine and lacustrine fishes; Some food fishes of India: *Wallago*, *Anguilla*, *Harpodon*, *Notopterus*, *Channa*, *Clarias*, *Labeo*, *Catla*, *Cirrhinus*, *Barbus*; Fish culture in India: Culture of Carps.

Unit 2- Domestication of animals

Animal husbandry and Poultry: Important breeds of cattle in India, Exotic breeds, cattle breeding, artificial insemination, feeding and management of dairy stock, dairy products. poultry industry in India, important poultry breeds, poultry farming, disease of fowl.

Unit-3- Apiculture and Sericulture

Apiculture: Importance of Bee keeping, Apiculture, *Apis* species, bee hive, social life of honey bee, properties of honey

Sericulture: Mulberry and non-mulberry Sericulture (tasar, munga and eri sericulture); lifecycle of silk moth; physical and chemical properties of silk.

Unit 4- Vermiculture

Introduction, ecology and distribution of earthworms: Vermiculture and vermicomposting methods: chemical composition of waste based vermicompost: Economics of vermiculture and vermicomposting: species of earthworms for vermicomposting; use of earthworm in land improvement and reclamation.

Suggested readings:

- 1 Bee keeping in India by A.M. Wadhvani
- 2 Poultry Husbandry by Morley A. Jull.
- 3 Domestic Water Buffalo by M.Fahimuddin
- 4 Life stock and Poultry Production by Harbans Singh and E.N.MOORE
- 5 Textbook of dairy chemistry by M.P. Mathur, D.D Roy, P.Dinaker

MSZ 205: Practical

Practical Examination particulars

Labelling of major Chordate systems (dissected)-10

Comparative osteology of different classes of vertebrates-10

Preparation- 05

Spotting (10)- 20

Economic Zoology Exercise- 05

Endocrinology and Developmental Biology Exercise- 05

Practical related to animal behaviour and evolution-05

Class record, tour and collection-10

Comprehensive viva - 05

TOTAL-75

Major Dissection Labeling: Labeling of cranial nerves of major representative types of fish and amphibian. Afferent and efferent branchial arteries of *Scoliodon*, urinogenital system of *Scoliodon*.

Comparative Osteology Study of bones of different chordate class with focus on evolutionary significance

Preparation- Placoid scale of *Scoliodon*. Ampulla of Lorenzini; T.S. through liver, intestine, skin etc. of frog.

Museum study- Study of museums and slides of representative types of Protochordates, Cyclostomata, fishes and amphibian, Reptiles, Aves and Mammals

Developmental Biology- Study of life stages of frog, mounting of eggs and embryo of frog, incubation and mounting of chick embryo, study of prepared slides of embryo of frog, chick and mammal, egg window

Endocrinology- Study of prepared slides of different endocrine glands of fish and frog, dissection of vertebrate types to demonstrate different endocrine organs

Field Study Field study at different Government/ Non-Government farm houses/ apiaries/ dairies/ poultries/ sericulture in local areas and project has to be submitted.

Museum study- Study of different culture animals (including fishes, cattles, poultry, bees, silk worm and earthworms)

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M. Sc. Final Year (Zoology)

Semester III

Paper I: MSZ 301–Cytology and Genetics

Unit-1

Basic concept of Mendelian inheritance, gene interaction, epistasis, complementation test, sex linked inheritance, sex limited and sex influenced trait, cytoplasmic inheritance, genomic imprinting, environment and heredity, pleiotropy, Genetic disease testing and gene therapy

Unit-2

Linkage, crossing over and recombination, recombination frequency, gene mapping, gene mutation, chromosomal mutation and their significance

Unit-3

Bacterial genome, transformation, transduction, conjugation, bacteriophage, Chromosomal organization of DNA in eukaryotes, transposable elements in prokaryotes and eukaryotes, role of transposable elements in genetic regulation

Unit-4

DNA replication in prokaryote and eukaryotes, chromosome and gene, gene expression and regulation- transcription in prokaryotes and eukaryotes, translation in prokaryotes and eukaryotes, uptake in endoplasmic reticulum, trafficking mechanism of protein, operon model- lac operon and trp operon

Suggested reading-

1. Genetics- Benjamin A pierce
2. Gardner et al Principles of Genetics John Wiley 1991
3. Hartl and Jones Genetics-Principles and Analysis Jones & Bartlett 1998
4. Hartwell et al Genetics: From Genes to Genomes McGraw-Hill 2004
5. Snustad and Simmons: Principles of Genetics (John Wiley & Sons)
6. Russell Genetics

Paper II: MSZ 302– Biostatistics, Bioinformatics and Bioinstrumentation

Unit 1- Biostatistics

Population sample, random sample, tabular and graphical representation of data; Measures of central Tendencies (Mean, Median, Mode), Standard deviation, Variance, Co-efficient of variance, Analysis of Variance (ANOVA).

Unit 2- Bioinformatics

Biology & IT, Computers in Biology and medicine, Introduction to Genomics and Proteomics etc.

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Definition and terminology: Cladogram, Dendrogram, Phylogram and Phenogram; Operational taxonomic unit (OUT), Informative sites. Biological sequence data banks (GENBANK, EMBL, PDB)

Unit 3- Biological Techniques

Working principles types and applications of Colorimetry, Spectrophotometry, Centrifugation, Chromatography and Electrophoresis.

Unit 4- Microscopy

Principles and Components of Compound microscope, Phase Contrast Microscope, Electron Microscope (SEM, TEM)

Suggested readings:

1. Statistical Methods (Eighth Edition) by G.W. Snedecor and W. G. Cochran.
2. Willey Blackwell Biostatistics (Tenth Edition) by W. W. Daniel and C.L. Cross, Wiley Introductory
3. Primrose: Molecular Biotechnology Panima 2001
4. Clark & Switzer: Experimental Biochemistry Freeman 2000
5. Bioinformatics-Sequence and Genome Analysis-David W. Mount, CSHL Press
6. Molecular Systematics, 2nd ed. D.M. Hillis, C. Moritz and B.K. Mable, Sinauer Associates, Sunderland, Massachusetts.
7. Fundamental Concepts of Bioinformatics, Krane, D.E. and Raymer M.L. Pearson

Paper III: MSZ 303- Special Paper

MSZ 303A: Fishery Biology- Taxonomy and Morphology

Unit 1

(i) Taxonomy Classification of fish up to orders as proposed by L.S. Berg (1940)

(ii) Systematic/Taxonomic study of fresh water fish with Special reference to identification of local forms (up to their families)

- 1-Order-Clupeiformes. Families-Clupeidae, Notopteroidae
- 2-Order-Beloniformes. Families-Belonidae, Hemiramphidae
- 3-Order-Mastacembeliformes. Family -Mastacembelidae
- 4-Order-Mugiliformes. Family-Mugilidae

Unit 2

Identification of Fish Study and preparation of identification key of the fish of following order with suitable diagrams, fin formula, local and biological names

1. Ophiocephaliformes
2. Cypriniformes
3. Perciformes

Unit 3

Study of differentiating characters of pair of fish from the orders of Fresh water fish given in to (Ophiocephaliformes, Cypriniformes and Perciformes) with special reference to fin formula, suitable



diagrams, local and biological names.

Unit 4

(i) Morphology Specialized organs (electric organs, poison glands, sound producing organs, light producing organs and sense organs)

(ii) Endocrine glands (Pineal, hypophysis, thyroid, adrenal, ultimobranchial body, corpuscles of stannius and urophysis).

MSZ 303B: Entomology- Morphology, Physiology, Development and Ecology

Unit 1- Morphology

Structure and nature of integument

Morphology of head (antennae and mouthparts), thorax (legs, wings, venation and coupling mechanism) and abdomen (external genitalia)

Nervous system and sense organs, Bioluminescence

Unit 2- Physiology

Anatomy of digestive system and nutritional physiology (nutritional requirement, feeding behaviour and food utilization)

Circulatory system and components of hemolymph, Excretory organs and physiology of excretion

Respiratory organs, physiology of respiration and respiratory adaptations of aquatic and endoparasitic insects. Reproductive organs and different modes of development

Unit 3- Development

Postembryonic development, Type of larvae and pupae, Hormonal control of Diapause

Unit 4 Ecology

Role of temperature, humidity and light in development and metamorphosis

Origin and evolution of apterygotes and pterygotes and their Interrelationships

MSZ 303C: Cell Biology- Cytological Techniques

Unit 1

Elementary principles of phase, interference, polarization, electron and Scanning electron microscope

Unit 2

Theory and application of freeze – drying, X-ray diffraction, radio autography, Fluorescent antibody techniques and differential centrifugation, Methods of tissue culture

Unit 3

Theoretical basis of colorimetric and biochemical estimations of nucleic acid, proteins

Unit 4

Chemical basis of fixation and cytochemical localization of proteins, lipids, glycogen, RNA, DNA, phosphatases, Biosynthesis of proteins and Nucleic Acids

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MSZ 304: Practical

MSZ 304 A: GENERAL

Practical Examination particulars

Field study-05

Preparation- Microtomy-05

Cytology and genetics exercise- 05

Biostatistics exercise- 05

Spotting (05)- 10

Class Record, Collection and Viva-05

MSZ304 B- SPECIAL

Practical Examination particulars

Fishery Biology

Major dissection-10

Preparation- 05

Identification of one fish - 05

Spotting (05)- 10

Seminar-05

Class record, collection and viva-05

Entomology

Major dissection-10

Minor dissection-05

Identification of one insect - 05

Spotting (05)- 10

Seminar-05

Class record, collection and viva-05

Cell Biology

Cytological localisation-10

Vital staining- 05

Microtomy - 05

Spotting (05)- 10

Seminar-05

Class record, collection and viva-05

Cytology and Genetics exercise- Demonstration of mitochondria in human buccal epithelium by supra vital staining. Study of mitosis in onion root tip and meiosis in testis of grasshopper with acetocarmine squash method. Study of salivary gland chromosomes of *Drosophila* and *Chironomus*. Study of the pattern of different hereditary traits in human beings

Biostatistics exercise- Experiments on probability, sampling of data for frequency diagram and calculation of mean, median and mode and standard deviation.

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Preparation- Microtomy of tissues (from block making to section cutting, stretching etc.)

MSZ305- RESEARCH PROJECT [ONLY LITERATURE REVIEW]

Candidate has to perform literature survey related to any book, article or journal on any topic of their choice in biological science.

Candidates are evaluated on 100 marks consisting 4 credits

Semester IV

Paper I: MSZ 401 – Molecular Biology

Unit 1- Gene Action

Chromosomal organization of genes, DNA Replication, Transcription, Genetic code

Unit 2- Intracellular Protein Trafficking

Protein Architecture, Protein synthesis on free/bound polysomes, Uptake into ER, Trafficking mechanism of proteins

Unit 3- Regulation of Gene Action

Regulation of Gene action in prokaryotes and eukaryotes, Operon model- Lac operon and Trp operon

Unit 4- Cell Signaling

Types of Cell Signaling, Second messenger system, Cell surface receptors

Suggested readings

1. Gardner et al Principles of Genetics John Wiley 1991
2. Hartl and Jones Genetics-Principles and Analysis Jones & Bartlett 1998
3. Hartwell et al Genetics: From Genes to Genomes McGraw-Hill 2004
4. Gilbert Developmental Biology Sinauer 2003
5. Snustada and Simmons Principles of Genetics JohnWiley& Sons
6. Russell Genetics BenjaminCummings

Paper II: MSZ 402-Special paper I

MSZ 402A - Fishery Biology: Applied Ichthyology and development

Unit I

- (i) Fisheries of India; Brief study of Marine, fresh water, estuarine and coldwater fishery.
- (ii) Fish Farming- Type of fish farming, fish ponds, construction of fish ponds, physio-chemical and biological characteristics of ponds
- (iii) Fertilization and management of fishery pond (spawning, hatcheries, reusing, stocking), transport, mortality of fish fry
- (iv) Composite culture and cage culture

Unit 2

- (i) Principle and importance of fish preservation, traditional and advanced methods of fish preservation sun-drying, salting, pickling, smoking, chilling, frying and canning etc.
- (ii) Fish products like oil, fish sauce, fish glue etc.

Unit 3

- (i) Application of genetics in aquaculture—sex manipulation, chromosomal manipulation, gene engineering.
- (ii) Transgenic fish
- (iii) Production of monosex and sterile fish and their Significance in aquaculture
- (iv) Induced breeding

Unit 4

Development: Gastrulation, Neurulation: Organ formation, Larval development: Metamorphosis

MSZ 402B- Entomology: Evolution and Taxonomy

Unit 1

Origin and evolution of apterygotes and pterygotes and their interrelationships

Unit 2

Thysanura: Machilidae; Lepismatidae Dictyoptera: Blattidae; Mantodeidae

Orthoptera: Tettigoniidae; Acrididae; Gryllidae; Gryllotalpidae

Isopoda: Termitidae; Kalotermitidae Sipunculata: Pediculidae; Haematopodidae

Hemiptera: Cicadidae; Jassidae; Lacciferidae; Coccidae; Cimidae; Pyrrhocoridae Belostomatidae

Unit 3

Lepidoptera: Pyralidae; Saturniidae; Bombycidae; Pieridae; Papilionidae; Lymantriidae; Noctuidae

Diptera: Culicidae; Simuliidae; Chironomidae; Tabanidae; Drosophilidae, Tachinidae; Muscidae; Hippoboscidae.

Unit 4

Hymenoptera: Ichneumonidae; Aphididae; Formicidae; Vespidae; Apidae; Bombycidae

Coleoptera: Cicindellidae; Carabidae; Hydrophilidae; Scarabaeidae; Lampyridae;

Tenebrionidae; Meloidae; Chrysomelidae; Curculionidae.

MSZ 402C: Cell Biology- Cell structure and function

Unit 1

Organization of cell; Ultrastructure and functions of Cell membrane and Nuclear membrane

Unit 2

Cellular Organelles: Ultrastructure and Functions

Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes, Lysosomes

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Unit 3

Cell division and cell cycle; Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle, Mechanism of chiasma formation

Unit 4

Cell transformation and cancer; apoptosis, necrosis and autophagy; Chromosomal changes caused by ultraviolet and ionizing radiations; Carcinogenesis: Cytopathology; Possible somatic and viral causes

Paper III: MSZ 403-Special paper 2

MSZ403A: Fishery Biology-Physiology and ecology

Unit 1

Nutrition-Alimentary canal, associated glands, Food and feeding habits, digestion,

Excretion-Kidney structure and modifications nitrogenous and excretory products, Urine formation and Osmoregulation- Definition, osmoregulation in freshwater, marine and migratory fishes.

Unit 2

Respiration- Structure and function of gills; Fish blood, process of respiration in a typical fish; Accessory respiratory organs;

Circulatory System-Heart structure and function, Blood vessels, Arterial and venous system

Unit 3

Reproduction-Gonads structure, spermatogenesis, Oogenesis, gonadal steroids, endocrine control of reproduction; Common enemies, symptoms etiology and treatment of disease of food fishes

Unit 4

Ecology:

Abiotic factors: Density; Pressure; Temperature; salt content in water; Light; Sound; Electric currents; Bottom deposits; Particles suspended in water.

Biotic factors: interspecific relationship among fishes and with other organisms; Intraspecific into relationship among fishes.

Pollutants affecting fishery water with special reference to oil spills, domestic pollutants, industrial water, radioactive wastes and sewage fed fisheries.

Plankton in relation of fish production

MSZ 403B: Entomology- Economic Entomology

Unit 1

Pests of Stored Grains: *Sitophilus oryzae*; *Tribolium castaneum*; *Challosobruchus chinensis*; *Corcyra cephalonica*; *Sitotroga cerealella*

Pests of Cotton: *Dysdercus spp*; *Earias vitella*; *Pectinophora gossypiella*

Pests of cereal-crops: *Helicoverpa armigera*; *Chilo zonellus*; *Leptocorysa varicornis*; *Hieroglyphus spp*.

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Unit 2

Pests of fruits: *Idiocerus atkinsoni*; *Dacus cucurbitae*; *Papilio demoleus*;

Pests of oil-seeds: *Bagrada cruciferarum*; *Athalia proxima*;

Lipaphis erysimi; *Leucinodes orbonalis*

Unit 3

Different methods of insect management: Cultural, Mechanical, Biological and Chemical; Integrated pest management (IPM); Properties, formulations, methods of application and mode of action of insecticides. Physiology of insect resistance to insecticides

Unit 4

Life-history of beneficial insects; Life-history and biology of silk -worm and its products; Life-history and biology of honey-bee and its products. Life - history and biology of lac - insect and its products.

MSZ 403C: Cell biology- Cell Regulation and Principles of Biotechnology

Unit 1

Regulation of cellular function; Hormone action: Hormone receptor Interaction; Membrane receptors: Steroid thyroid and epinephrine receptors; Second messengers (cyclic AMP: Cyclic GMP); Interferon.

Unit 2

Genetic code; Genetic recombination, transformation, conjugation and transduction

Unit 3

Application of genetic engineering and its prospects
Microbes and human welfare

Unit 4

Thermodynamic principles and steady-state conditions of living Organisms; Organization and methods to study metabolism; Degradation of glucose and nucleotides in animals; Energy metabolism and high energy compounds. Redox potentials; Mitochondrial electron transport chain. Oxidative phosphorylation; Nature of enzymes. Classification and nomenclature of enzymes. Kinetic analysis of enzyme catalyzed reactions.

MSZ 404A AND MSZ 404B-Practical

Practical examination particulars

Practical general (MSZ 404A)

Practical related to molecular biology- 20

Spotting (05)- 10

Class Record, Collection and Viva-05

Practical special (MSZ 404B)

Fishery Biology

Major dissection-10

Minor dissection- 05

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Preparation- 05
Ecology exercise- 05
Spotting (05)- 10
Class record, collection and viva-05

Entomology

Major dissection-10
Minor dissection-05
Preparation – 05
Physiology exercise- 05
Spotting (05)- 10
Class record, collection and viva-05

Cell Biology

Quantitative estimation-10
Cytological preparation -10
Microbial exercise- 05
Spotting (05)- 10
Class record, collection and viva-05

Molecular Biology exercise- Isolation and colorimetric determination of protein from fat bodies of cockroach and liver Isolation and colorimetric determination of DNA from fat bodies of cockroach and liver

MSZ 405- Research project

Candidate has to complete research project in this semester on the topic which was already chosen by him/her in 3rd semester. Research project can be of type dissertation/internship/field survey.
Candidates are evaluated on 100 marks consisting 4 credits

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