GOVT. D. B. GIRLS' P. G. COLLEGE, RAIPUR (C.G.)

SYLLABUS
M. Sc. ZOOLOGY

2020 - 2021, 2021 - 2022

GOVT. D. B. GIRLS PG COLLEGE, RAIPUR

CHHATTISGAH

Afiliated With

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

SYLLABUS FOR 2020 - 21, 2021 - 22

M. Sc. ZOOLOGY

Semester	Paper	Title	External marks	Internal marks	Credit
First JULY-DEC, 2020	I	Systematics zoology and Invertebrate zoology	**80**	**20**	4
	II	Tools & Techniques in Zoology	**80**	**20**	4
	III	Endocrinology-Comparative and Molecular	**80**	**20**	4
	IV	Gamete Biology and Reproduction Physiology	**80**	**20**	4
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**	2
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**	2
Second JAN-JUNE, 2021	I	Molecular Biology and Biotechnology	**80**	**20**	4
	II	Environment Biology and Environment Physiology	**80**	**20**	4
	III	Immunology & Development Biology	**80**	**20**	4
	IV	Biostatistics and Computer Application	**80**	**20**	4
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**	2
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**	2
Third JULY-DEC, 2021	I	Comparative Anatomy of Vertebrate	**80**	**20**	4
	II	Animal Behaviour	**80**	**20**	4
	III	Population Genetics and Evolution	**80**	**20**	4
	IV	Cytogenetics	**80**	**20**	4

	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**	2
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**	2
Fourth JAN-JUNE, 2022	I	Neurophysiology and Human Physiology	**80**	**20**	4
	II	Biochemistry and Metabolic regulation	**80**	**20**	4
	III	Fish (ichthyology) structure and function	**80**	20	4
	IV	Aquaculture and Fisheries	**80**	**20**	4
Total	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**	2
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**	2

* The respective teachers on each paper will ensure the internal evaluation by a class test and a seminar/ poster presentation of 20 marks for M. Sc. each and submit the foil and counter foil to the HOD by the end the activity.
** Lecture for each unit are 15

M.Sc. ZOOLOGY SEMESTER - I
PAPER – I
SYSTEMATIC ZOLOGY AND INVERTEBRATE ZOOLOGY

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

- Historical resume of systematics.
- Importance and applications of biosystematics in biology
  - Chemotaxonomy
  - Cytotaxonomy
  - Molecular taxonomy
- Mechanisms of speciation in panmictic and apomictic species
- Species concepts and species category.
- Theories of biological classification.
- Taxonomic characters and different kinds.

UNIT-II

- Taxonomic procedures-taxonomic collections, preservation, curetting
- Taxonomic keys-different kinds of taxonomic keys, their merits and demerits.

- Process of typification and different Zoological types.
- International code of Zoological Nomenclature (ICZN)

- Biodiversity
  - Types of Biodiversity
  - Hot spots of Biodiversity
  - Threats to Biodiversity
  - Conservation of Biodiversity
- Evaluation of biodiversity indices
  - Shannon-Weiner index.

UNIT-III

- Organization of coelom
  - Acoelomates and Pseudocoelomates
  - Coelomates: Protostomia and Deuterostomia.
- Locomotion
  - Flagellar and ciliary movement in Protozoa.
  - Hydrostatic movement in Coelenterata, Annelida and Echinodermata.
- Nutrition and Digestion
  - Patterns of feeding and digestion in Protozoa
  - Filter feeding in polychaeta.
- Respiration
  - Organs of respiration Gills, lungs and trachea.
  - Respiratory pigments.

UNIT-IV

- Excretion
  - Organs of excretion.
  - Excretion and osmoregulation
- Nervous System
  - Primitive nervous system: Coelenterata and Echinodermata.
  - Advanced Nervous system: Annelida, Arthropoda (Crustacea and insecta) and Mollusca (Cephalopoda)
- Invertebrate larvae
- Larval forms of free-living and parasitic invertebrates
- Minor Phyla - Organization and general characters of (Ctenophore, Rotifera, Ectoprocta, Endoprocta

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Biosystematics & Taxonomy**, **Dr.R.C.Tripathi**, University Book House JAIPUR.
- **Theory & Practice of Animal Taxonomy** **V.C. Kapoor,** 5th Edition Oxford & IBH Publishing Co.
- **Principle of Animal Taxonomy** **G.G. Simpson,** Oxford & IBH Publishing Co.
- **Elements of axonomy** **Earnst Mayer**
- **Biodiversity** **E.O. Vilson,** Acadmic Press Washington
- **The Biology of Biodiversity** **M. Kato,** Springer

- **Molecular Markers - Natural History & Evolution J.C. Avise**
- **Invertebrate Structure and function:-**
  E.J.W. Barrigton English language Book society UK.
- **Invertebrate Zoology:**
  Robert Barnes IVth Edition Holt Saunders International Edition Japan.
- **The Cambrige Natural History Vol 1 - 9.**
  S F Harmer, A.E. Shipley.
  Todays & Tomorrows Book agency, N Delhi India.
- **A Text book of Zoology Invertebrate:**
  Parker Hasvell, Marshall & Williams. AITBS Publishing & Distributers, Delhi
- **The Invertebrates Vol. 1 - 9**
  Libbic Henrietta Hyman, McGraw Hill Book Company

M.Sc. ZOOLOGY SEMESTER - I

PAPER – II:
TOOLS & TECHNIQUES IN BIOLOGY

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

1.Principles and application of
1.1 Ultracentrifugation
1.2 Electrophoresis
1.3 Chromatography (various types)
1.4 Lambert-Beers Law and colorimetery and spectrophotometery
1.5 Flow cytometery.

UNIT-II

2. Principles and Application of
2.1 Light Microscopy and micrometry
2.2 Phase Contrast microscopy
2.3 Interference microscopy
2.4 Fluorescence microscopy
2.5 Transmission Electron microscopy.
2.6 Scanning Electron microscopy.

UNIT-III

3. Assay
3.1 Chemical assays
3.2 Biological assays-in vivo and in vitro
4. Principles of cytological and cytochemical techniques

4.1 Fixation: chemical basis of fixation by formaldehyde, gluteraldehyde, chromium salts, mercury salts, osmium salts, alcohol and acetone
4.2 Chemical basis of staining of carbohydrate, protein lipids and nucleic acids.

UNIT-IV
5. Principle and techniques of
5.1 Nucleic acid hybridization and cot curve
5.2 Sequencing of proteins and nucleic acids
6. Freeze techniques
7. Media preparation and sterilization
8. Inoculation and growth monitoring

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Introduction to Instrumental Analysis**
  - **Robert Braun,** McGraw Hill International Edition
- **A biologist guide to principles and techniques of practical biochemistry**
  - **K Wilson and K. H. Goulding** ELBs Edition
- **Instrumentation**
  - **Upadhyay and Nath,** Meerut Publications
- **Instrumentation and Techniques**
  - **R.C. Bajpayee,** Himalayan Publications

M. Sc. ZOOLOGY SEMESTER - I

PAPER-III:

GENERAL and COMPARATIVE ENDOCRINOLOGY OF VERTEBRATES

Max. M.-80 **NUMBER OF UNITS: IV**

Unit 1

AIMS and scope of endocrinology-Types of chemical messengers, Discovery of hormones, Classification of endocrine glands and hormones, Experimental methods of hormones research

Comparative morphology of Endocrine tissue-Hypothalamus, Pituitary gland Thyroid, parathyroid, Adrenal, Gastrointestinal tract, Juxta-glomerular apparatus (kidney), Heart

Unit 2

Life history of hormones—

Biosynthesis of hormones**,** Biosynthesis of simple peptide hormone**,** Biosynthesis of amino acid derived small size hormone (T3, T4, epinephrine and nor-epinephrine) Biosynthesis of steroid hormone**,** (cortisol, cortisone, corticosterone, progesterone)

Release of hormone from endocrine gland Releasing stimuli, Pulsatile release of hormone, Releasing mechanism.

Concentration and transport of hormone in the blood

General mechanism of hormone action - Plasma membrane hormone receptor and its action**,** Cystosolic hormone receptor and its action

Termination of hormone action and metabolism of hormone

Unit 3

Neuroendocrine system - types of neurohormones, synthesis and function of endorphins, encephalin etc.

Synthesis, function and disorder of following endocrine gland hormones- Pituitary hormones, Adrenal hormones, Thyroid and parathyroid hormones, Gastro- intestinal hormones, Juxta-glomerular hormones, Hormones of heart, Synthesis and function of ecosanoid specially Prostaglandin and Luketerineand its hormonal role

Unit 4

Hormonal regulation and its metabolic activity-

Role of hormone in – Carbohydrate metabolism**,** Protein metabolism**,** Fat metabolism, and Calcium metabolism.

Role of hormone in fasting

Hormone & behaviour

Role of hormone in growth & development

Suggested Reading Materials-

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 Univ. Press
4. Comparative endocrinology : A. Gorbman et al, john Wiley and sons
5. Medical Physiology : W.F. Ganong(1981) :10th edition Lange Medical Publications
6. Principles of anatomy and physiology : Torota Grabowski, 9th edition, John Wiley & sons
7. Reproductive Physiology of vertebrates: Van Tienhoven, A,(1983) 2nd edition Cornell
8. Univ.Press,NY
9. The pituitary gland :Imura.H(1994)2ndeditionCompreshensive Endocrinology revised series Raven, NY
10. Comparative vertebrate endocrinology: Bentley, PJ.(1976),Cambridge Univ. press, Cambridge
11. Comparative vertebrate endocrinomental: Bentley, P.J(1976) Cambridge Univ. press, Cambridge
12. Invertebrate endocrinology:D.B. Temblare,Himalaya Publishing house
13. Endocrinology : Hadley
14. Endocrinology : Negi

M. Sc. ZOOLOGY SEMESTER - I

PAPER IV

GAMETE BIOLOGY & REPRODUCTIVE PHYSIOLOGY IN HUMAN BEINGS

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT 1

Endocrinology of sex differentiation & judgment-

Chromosomal (genetic) basis of sex determination**,** Gonadal sex**,** phenotypic sex differentiation of the internal and external genitalia**,** Brain sex differentiation **Reproductive cycle-**Adrenarche**,** Pubarche and puberty**,** ovarian cycle**,** Formation of ova**,** Luteal cycle**,** Uterine cycle**,** Menstruation cycle**,** Menopause**,** Estrous cycle

UNIT 2

Male reproductive system-Anatomy, physiology and morphology of male reproductive system**,** Spermatogenesis and development of spermatozoa**,** Biochemistry of semen**,** Phallus erection**,** Ejaculation**,** Y-specific probes

Endocrine function in male-Endocrine control of testicular function**,** Chemistry and biosynthesis of androgens**,** Secretion transport and metabolism of testis hormone**,** Physiological role of androgens-Role in spermatogenesis**,** Nervous system**,** Secondary sex characteristics**,** Anabolic function**,** Aging**,** Physiological roles of estrogens in male**,** Fertility**,** Male behaviour**,** Epiphyseal fusion**,** Cardio vascular function**,** Mechanism of androgen action and Pathophysiology

UNIT 3

Female reproductive system-Anatomy of female reproductive system-Ovary**,** Fallopian tube**,** Uterus**,** Oogenesis

Ovarian hormones-Chemistry, biosynthesis, secretion, transport, function, action and metabolism of Estrogens Progesterone and Relaxin**,** Control of ovarian function Abnormalities of ovarian function

UNIT 4

Fertilization-Pre-fertilization event**,** Biochemistry of fertilization**,** Post-fertilization event

Collection and **cryopreservation** of gametes and embryo

Formation and development of **Placenta** and its endocrine function

Role of hormone in **Parturition** and **Lactation**

Hormonal and **immune contraception**

Role of hormone in **Pregnancy**

Suggested reading material-

1. Developmental Biology, 2nd edition,Leon, W.B Saunders College publishing
2. Current topics in Developmental Biology eds. R.A.Pederson and G.P. Schatten
3. Principles of animal development biology: S.C. Goel, Himalaya Publishing house
4. Developmental biology, S.F Gilbert, 4th edition, Sinauer Assoc. Inc. Publishers
5. An introduction to Developmental biology : D.A. Ede
6. Principles of Developmental Biology:Paul Weiss edited by HafnerPublishngCo.,NY
7. Cells into organs: 2nd edition the forces that shape the embryo John PhillipTrinkaused, Tom Aloisi
8. Principles of development: LewisWolpert et al 1998. Oxford Univ. Press
9. Foundations of embryology; B.M Pattern & B.M. Carlson, Tata McGraw Hill Publications, New Delhi
10. An introduction to embryology: Balinsky 1981 5th ed. (CBS College publishing)
11. Embryonic and foetal development Cambridge Univ press. By Austin and Short 1982, 1992 2nd Ed.
12. Marshall physiology of reproduction: Longmont Green and Co. London Vol1 and 2, lamming 1984,2000
13. Developmental biology; Gudrick
14. Endocrinology: Hadley
15. Endocrinology: Negi

M.Sc. ZOOLOGY SEMESTER -I
PRACTICAL
LAB COURSE- I

I PAPER - Biosystematics and Taxonomy

1. Study of biodiversity among various invertebrates and vertebrates (Listing of all the animals found in and around your house and also try to find out their Zoological names).
2. Collection of various insect species.
3. Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report.
4. Study of adaptive characteristics of various invertebrates and vertebrates in different climate.
5. Study of biodiversity in grassland and pond water by using Shannon -Weiner index
6. Taxonomic key formation and conversion. AND Other exercise related to theory paper

I PAPER - Structure and function of invertebrates

1. Identification, classification and study of distinguishing features of important representatives from various groups (Protozoa to Hemichordata)**.**
2. Study of permanent prepared slides (from Protozoa to Hemichordata).
3. Alternate methods of dissection; Reproductive, Excretory, nervous and haemocoelomic systems of leech.
4. Alternate methods of dissection Reproductive system of cockroach; general anatomy, nervous and reproductive systems of grasshopper; nervous system of crab; nervous and reproductive systems of scorpion.
5. Alternate methods of dissection of Nervous system of Mytilus, Sepia and Aplysia, general anatomy of Aplysia.
6. Alternate methods of dissection for Study of sections of the arm of a starfish; general anatomy of a Holothurian; Aristotle's lantern of a sea urchin complete as well as disarticulated parts of the Aristotle's lantern.
7. Permanent preparations of different materials to be provided for study.
8. Wonder invertebrates AND Other exercise related to theory paper.

II PAPER - Tools and techniques in biology

1. Parts study, principles and use of following instruments for different techniques:

a. pH meter: Determination of pH of different soil and water samples.
b. Spectrophotometer: Preparation of absorption spectrum.
c. Chromatography: Paper and thin layer chromatography.
d. Centrifuge: Extraction proteins and carbohydrates from tissues.
e. Electrophoresis: Paper and gel electrophoresis.
f. Microscope: Parts study and principles of various microscopes.
g. Demonstration of cryostat.AND Other exercise related to theory paper.

Scheme of Practical Examination:	**Total Marks 100 marks.**
1. Experiment based on **Biosystematics and Taxonomy**	20 marks.
2. Experiment based on **Biosystematics and Taxonomy**.	20 marks.
3. Amino acid separation by Chromatography	10 marks.
4. Determination of pH	04 marks.
5. Spectrophotometer/electrophoresis experiment.	10 marks.
6. Parts study and principle and application of various studied instrument.	16 marks
7. Viva-voce	10 marks.
8. Sessional	10 marks.

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Prof. Ajit Hundet	Chairman	
Prof. Seema Gupta	V.C. Nominee	
Prof. V. K. Gupta	Principal's Nominee	
Prof. Maya Shedpure	Member	
Dr. K.K. Harris	Member	
Mrs. Priya Dewangan	Member	
Ms. Uma Gupta	Member	

Dr. Richa Tikariha	Member
Ms (CR) M.Sc. III sem.	Member

M.Sc. ZOOLOGY SEMESTER -I
PRACTICAL
LAB COURSE- II

PAPER -III. General and Moecular Endocrinology

1. Alternate methods of dissection and exposure of major endocrine glands in an experimental animals.
2. Study of histology of endocrine glands in different animal types through permanent slides
3 Microtomy.
4 Chromatography method (separation of Androgen & Progestrone).
5 Bioassay of α-Ketosteroids.
6 Bioassay of Gnadotropins.
7 Study of slide related to endocrine glands.
8 Estimation of cholesterol.
9 Estimation of catecholamines. And Other exercise related to theory paper.

PAPER -IV. Gamete Biology

1. Study of slides of development of frog.
2. Study of development of Hen's egg, by cover glass window method, staining and mounting of blastodisc.
3. Study of caudal regeneration in Teleost (Meal time effect).
4. Study of embryological slides: spermatogenesis, oogenesis, histology of gonads.
5. Study of effect of NaF on growth of fish fingerlings.
6. Study of effect of thyroid hormone on metamorphosis of tadpole
7. Other exercises related to theory paper

Scheme of Practical Examination:

1. Experiments based **Gamete Biology**	15 marks
2. Experiments based **Gamete Biology**	10 marks
3. Experiments based **Endocrinology**.	15
4. Alternate methods of dissection and exposure of major endocrine glands	10 marks
5. Comment on Slides (Endocrine gland) Spot 1-5	10 marks
6. Slide Preparation (microtomy, Two Slides)	10 marks
7. Viva-voce	10 marks
8. Sessional	20 marks

Total Marks 100 marks.

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Prof. Ajit Hundet	Chairman	
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Prof. V. K. Gupta	Principal's Nominee	
Prof. Maya Shedpure	Member	
Dr. K.K. Harris	Member	
Mrs. Priya Dewangan	Member	
Ms. Uma Gupta	Member	
Dr. Richa Tikariha	Member	

Ms (CR) M.Sc. III sem. Member

M. Sc. ZOOLOGY SECOND SEMESTER - II

PAPER – I

MOLECULAR CELL BIOLOGY AND BIOTECHNOLOGY

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

- Biomembranes
  - Molecular composition and arrangement Transport across membrane
  - Structure and Function Mitochondria
  - Golgi complex Lysosome Ribosome
  - **Cytoskeleton-**Microfilaments and microtubules-structure and dynamics**,** Role of microtubules in mitosis**,** Cell movements- intracellular transport role of kinesin and dynein**,** Signal transduction mechanism
  - Cilia and flagella

UNIT-II

DNA replication
Transcription

- Translation
- Genetic code
- Mechanisms of initiation, elongation and termination
- Regulation of translation

UNIT-III

- Genome organization
  - Chromosomal organization: morphological and structural types.
  - Non-coding DNA
- Molecular mapping of genome
  - Genetic and physical maps
  - Polymerase Chain Reaction (PCR) and blotting techniques
  - Molecular markers in genome analysis.

UNIT-IV

- Transgenic animals and knock-outs
  - Production and applications
  - Embryonic stem cells
  - Application of genetic engineering
  - Medicine
  - Agriculture
  - Industry

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

. **MOLECULAR CELL BIOLOGY** **Lodish,** W.H. Freeman & Co. NewYork

- **Lehninger PRINCIPLES OF BIOCHEMISTRY,**

  Fourth Edition - David L [1]. Nelson, Michael M. Cox

- **MOLECULAR CELL BIOLOGY**

  Lodish M. Baltimore, Scientific American books

- **ESSENTIALS OF CELL & MOLECULAR BIOLOGY**

  Roberties & Roberties, Halt Saunders International Edition.

- **CELL & MOLECULAR CELL BIOLOGY**

  Gerald Karp, Willey & Sons Co.

- **MEDICAL CELL BIOLOGY**

  Flickinger E.J. Brown J.C. Halt Saunders International Edition.

- **CELL BIOLOGY**

  Powar C.B. Himalaya Publishing House

M. Sc. ZOOLOGY SECOND SEMESTER - II
PAPER – II
Environment Biology and Environment Physiology

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT- I

1. Ecology
1.1 Definition, concept and scope of ecology.
2. Structure and components of ecosystem.
3. Types and functions of ecosystem.
4. Ecological modeling.
5. Limiting factors
5.1 Energy flow, food chain, food web and trophic levels, ecological pyramids.
5.2 Ecological succession
5.3 Biogeochemical cycles: water cycle, carbon, oxygen and nitrogen cycles.

UNIT-II

6. Population dynamics
6.1 Dynamics of population growth.
6.2 Factors that increase or decrease population.
7. Community dynamics
7.1 Characteristics and composition
7.2 Development and classification of communities.
8. Renewable and non-renewable resources: Forest, water and mineral resources.
9. Conservation of energy sources.
10. National Parks, Wild life sanctuaries and biosphere reserves.

UNIT-III

11. Adaptations
11.1 Levels of adaptation.
11.2 Mechanisms of adaptation.
2. Adaptations to different environments.
12.1 Marine, shores and estuaries.
12.2 Freshwater.
12.3 Terrestrial Life.
13. Adaptations to different environments.
13.1 Aerial
13.2 Polar
13.3 Deep sea environment
13.4 Desert, Cave
13.5 Wet land
13.6 Parasitic habitats.

UNIT-IV

14. Stress Physiology

14.1 Basic concepts of environmental stress and strain, Concept of elastic and plastic strain.
14.2. Stress avoidance, stress tolerance and stress resistance.
14.3. Acclimatization, acclimation and adaptation.
14.4. Endothermic and physiological mechanism of regulation of body temperature.
15. Stress physiology in different conditions
15.1 Osmoregulation in aqueous and terrestrial habitats.
15.2 Physiological response to oxygen deficient stress.
15.3 Physiological response to body exercise.
15.4 Effect of meditation and yoga

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

ECOLOGYwithspecialreferenceto animal& man

S. Charles,Kendeigh Prentice hall of IndiaPvt.Ltd. NewDelhi

- **ELEMENTS OF TROPICAL ECOLOGY**
  - **Yanney Ewusie** (English language Book Society, Heine mann educational book publication)
- **FUNDAMENTALS OF ECOLOGY**
  - **Odum P.**
- **ANIMAL PHYSIOLOGY, MECHANISM AND ADAPTATION -**

Eckert, R., W,H, Freeman and Co.

- **BIOCHEMICAL ADAPTATION -**

Hochachka, P.W, and Somero S.N, Princeton, New Jersey

- **ANIMAL PHYSIOLOGY: ADAPTATION AND ENVIRONMENT.-**

Schiemidt Nielsen, Cambridge

GENERAL & COMPARATIVE ANIMAL PHYSIOLOGY

Hoar W.S. Princeton Hall of India

- **ENVIRONMENTALPHYSIOLOGY**

Willmer, P.G. Stone & Johansan I, Blackwell Science Oxford

M. Sc. ZOOLOGY SEMESTER - II

PAPER – III

IMMUNOLOGY & DEVELOPMENT BIOLOGY

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

Innate and Acquired immunity, Cell and Organs of Immune System, Organization and Structure of Lymphoid organs, Cells of the immune system & their differentiation Lymphocyte traffic, Nature of Immune response, Nature of Antigens, Antigenicity and Immunogenicity, Factor influencing immunogenicity, Antigenic determinates/epitopes and heptens.

UNIT- II

Antibodies (Immunoglobulin's), Structure & Function of antibodies, Immunoglobulin Classes & Subclasses, Antigen- Antibody interaction, B-Cell Maturation, Activation and Differentiation, B-Cell Receptors, B-Cell Activation and Proliferation, Humoral Immune Response Kinetics, T-Cell maturation activation and differentiation, T- Cell Receptors, T- Cell Activation and Proliferation, T- Cellular Immune Response

UNIT- III

Compliment System, Complement Component, Regulation of Compliment System, Consequence of Compliment Activation, Major and Minor Histocompatibility Complex Inheritance of HLA System, Location and Function, Structure of MHC molecule, Peptide interaction with MHC molecule, Cellular distribution and regulation of MHC expression, MHC & Susceptibility to infectious disease, Hyper sensitivity and immune responses to infectious agents especially intra cellular parasites

UNIT- IV

The development of Primitive Embryonic form, Cleavage (Segmentation) and Blastulation, Chordate Blastula and its Significance, The late Blastula in relation to Certain Innate Physiological Conditions: Twinning Gastrulation, Tabulation and extension of the Major Organ forming Areas: Development of Primitive body form Basic Feature of Vertebrate Morphogenesis, Histogenesis and Morphogenesis of the Organ System, The Cardio Vascular System, The Nervous System. Teratology

Suggested Reading Materials –

1. Immuniology by Kuby, W. H. Froeman USA
2. Fundamental of Immunology by W. Paul
3. Essential Immunology by M. Rohit, ELBs Edition
4. Immunology by Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications
5. Reproductiove Physiology by Guyton
6. Animal Gametes – Vishmanath, Asia Publishing House
7. Foundation Of Embrology Bradley M.Patten, McGrow Publication
8. Fertilization In Animals Brain Dale, Arlond Heiniman, Gulab Vazerani Publication
9. Development Biology N.J. Berril, Tata McGraw Hill Publication N. Delhi
10. Embryology Of Vertebrates - Nelson

M. Sc. ZOOLOGY SEMESTER - II

PAPER IV

QUANTITATIVE BIOLOGY AND COMPUTER APPLICATION)

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

1. Introduction to digital computer and application
   - 1.1 Basic knowledge of hardware and software
   - 1.2 CPU (Central Processing Unit)
   - 1.3 Input and Output devices
   - 1.4 Auxiliary storage system
   - 1.5 Operating systems: Windows, Android
   - 1.6 Binary number system

UNIT-II

2. Computer application
   - 2.1 Introduction to MS office
     - 2.1.1 Word
     - 2.1.2 Excel
     - 2.1.3 PowerPoint
     - 2.1.4 Virtual e- learning Platforms
       - 2.1.4.1 Google Platforms (Classroom, Meet, G-Suite & Workspace)
       - 2.1.4.2 Microsoft Group
       - 2.1.4.3 Zoom and related applications
3. Introduction to web browsing software and search engines with special reference to online resources.
4. Use of SPSS

UNIT-III

5. Types of biological data
6. Representation of data (Tabular and Graphical)
7. Sampling methods

8. Measures of central tendency: arithmetic mean, mode, median for ungrouped and grouped data.
9. Measures of dispersion: range, mean deviation, variance, standard deviation and standard error.
10. Skewness, Kurtosis
11. Hypothesis testing: Null and alternate hypothesis

UNIT-IV

11. Tests of significance
    - 11.1 Chi-square test
    - 11.2. Student's t-test
    - 11.3 parametric and non - parametric tests.
    - 12. Analysis of Variance
    - 13. Simple linear regression
    - 14. Correlation: Pearson's correlation coefficients.
    - 15. Probability distribution: normal, poisson and binomial

SUGGESTED READING MATERIALS

Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling

-Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.

• Snedecor, G.W. and W.G. cochran, statical methods, Affilited East,
West Press New Delhi (Indian ed.)

• Muray , J.D. Methamatical Biology, Springer Verlag Berlin

• Pelon, E.C. The interpretation of ecological data : A promer on
classification and ordivation.

A. lewis . Biostatics

• B.K. Mahajan Methods in Biostatics

• J.D. Murrey Mathematical Biology

• Georgs & Wilians Startical method

M.Sc. ZOOLOGY SEMESTER -II
PRACTICAL
LAB COURSE- I

PAPER – I -Molecular biology and Biotechnology

1 Isolation of DNA/RNA
2 Study of mitochondria from buccal epithelium by staining with supravital stains.
3 Culture of amoeba, paramecium, euglena.
4 Study of cell division mitosis/meiosis by squash and smear preparation of root tip and cockroach/grasshopper testis.
5 Study of giant chromosome in the salivary gland of Chironomous larvae or Drosophila.
6 Study of Barr body and human chromosome.
7 Culture and study of drosophila.
8 Preparation of culture media and culture of bacteria.
9 Other exercises related to theory paper.

PAPER – II - Environment Physiology

1. Study of the effects of starvation / surfacing prevention on opercular activity in a teleost fish
2. Study of effect of fluoride toxicity on muscle protein in a fish.
3. Study of changes in chromatophores in fish kept against white and black backgrounds.
4. Toxicity test (LC 50)
5. Adaptive modification of feet or claws in birds.
6. Adaptive modification in mouth parts of insects.
7. Analysis of soil and water.
8. Other exercises related to theory paper.

PAPER – II - Environmental Biology, Population ecology

1. Study of biotic community in a pond/grassland ecosystem.
2. Study of population growth rate (curve) in protozoan culture.
3. Population dynamics of *Tribolium* sp.
4. Study of biogeochemical cycles by way of models.

5. Visit to some natural habitats and man made habitats to study the human impact on environment.
6. Water analysis for fresh and waste water (Dissolve oxygen and chloride).
7. Other exercises related to theory paper.

Scheme of Practical Examination:

1	Experiment on molecular biology	20 marks.
2.	Culture Experiment	20 marks
3	Exercise based on Environmental biology	20 marks
4.	Exercises based on Environmental physiology	20 marks
5.	Viva-voce	10 marks
6.	Sessional	10 marks.

Total Marks 100 marks .

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M.Sc. ZOOLOGY SEMESTER -II

PRACTICAL

LAB COURSE- II

I. Quantitative biology and computer application

1. Preparation of frequency tables and graphs.
2. Calculation of standard deviation, variance and standard error of mean.
3. Calculation of probability and significance between means using t-test,Chi-square test, ANOVA
4. Calculation of correlation, regression and probability distribution.
5. Computer software use for computational tasks, data presentation, design task and Communication

II. IMMUNOLOGY

1 Other exercises related to theory paper.
2. Alternate methods of dissection of primary and secondary immune organs from
3 fish/fowl- Preparation and study of cell suspension from spleen (spleenocytes) of Fish /fowl.
4. Total and differential counting of leucocytes.
5. Protein estimation by Lowry's method in normal and infected blood sample.
6. Determination of Blood group.
7. Study of permanent slides (for spotting); thymus, lymph nodes, spleen, bone marrow, types of cells squamous, cuboidal, columnar, epithelial cells, blood cells, nerve cells, muscles cells, connective tissue of various types, adipose tissue, mitotic and meiotic chromosomes and their different phases cancer cells of various types etc

II. Development biology

1. Study of slides of development of frog.
2. Study of development of Hen's egg, by cover glass window method, staining and mounting of blastodisc.
3. Study of caudal regeneration in Teleost (Meal time effect).
4. Study of embryological slides: spermatogenesis, oogenesis, histology of gonads.
5. Study of effect of NaF on growth of fish fingerlings.

6. Study of effect of thyroid hormone on metamorphosis of tadpole
7. Other exercises related to theory paper

Scheme of Practical Examination:

1. Exercise based on Biostatistics.	20 marks.
2. Two exercises based on Computer application.	20 marks.
3. Experiments based on **IMMUNOLOGY**.	20 marks.
4. Exercise based on Developmental Biology.	20 marks
5. Viva-voce	10 marks.
6. Sessional	10 marks.

Total Marks 100 marks.

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M. Sc. ZOOLOGY SEMESTER - III
PAPER- I
COMPARATIVE ANATOMY OF VERTEBRATES

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

1. Origin of Chordates

1.1 Amphibians, Reptiles, Birds and Mammals.

2. Classification of Vertebrates

2.1 Amphibians

2.2 Reptiles

2.3 Birds

2.4 Mammals.

UNIT-II

3. Vertebrate integument and its derivatives.

3.1 General structure and functions of Integument.

3.2 Structure and functions of glands, scales, horns, claws, nails, hoof, feather and hair.

4. Skeletal system in vertebrates.

4.1 Comparative account of (i) Jaw suspensorium, (ii) Limbs and Girdles.

UNIT-III

5. Respiration in Vertebrates.
5.1Comparative account of respiratory organs (structure and functions).
6. Circulation in Vertebrates.
6.1 Structure and function of blood.
6.2 Evolution of heart.
6.3 Evolution of aortic arches.

UNIT-IV

7. Nervous System – Central, Peripheral and Autonomic.
8. Sense organs.
8.1 Comparative account of Sensory Receptors.
9. Evolution of Urinogenital system in vertebrates.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Vertebrate life** :– William N. Ferland, F. Harvey pough, Tom J Gode, John B. Heiser
- Collier MacNillem International edition
- **Chordate morphology** :–Malcom Jollie
- Reinhold Publishing Corporation NewYork
- **Chordate –Structure & Function** :- Arnold G. Khage, B.E. Fry Johanson
- Mc Millan Publishing Co. INC. NewYork
- **Comparative Animal Physiology** :- Orosser
- Satish Book Enterprises, Agra
- **The Vertebrate Body** :- Alfred Sherwood Romer
- Vakils, Feffer & Simons Publications Ltd.

M. Sc. ZOOLOGY (SEMESTER-III)

PAPER- II

ANIMAL BEHAVIOUR

Max. M. – 80 **NUMBER OF UNITS: IV**

UNIT- I

1. Historical perspectives- Ethology
2. Behavioural patterns
3. Innate behaviour
4. Biological rhythms
4.1 Types of biological rhythm
4.2 Biological clock

UNIT- II

5. Communications
5.1 Auditory
5.2 Visual
5.3 Chemical
6. Learning and Memory
6.1 Conditioning
6.2 Habituation

7. Reasoning
8. Reproductive behaviour.

UNIT-III

9. Orientation
10. Echolocation in bats
11. Bird migration and navigation.
12. Fish migration.
13. Neural and hormonal control of behaviour

UNIT-IV

14. Hormonal effect on behavioural patterns.
15. Social behaviour
15.1 Social organization in insects and primates
15.2 Schooling in fishes and Flocking in birds
15.3 Homing, territoriality, dispersal
15.4 Altruism
15.5 Host–parasite relation

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **ANIMAL BEHAVIOR – Mc Farland** (English Language Book Society)
- **ANIMAL BEHAVIOR – Arora M.P.** (Himalaya Publishing House, Mumbai)
- **ANIMAL BEHAVIOR - Reena Mathur** (Rastogi Publications,Meerut

M. Sc. ZOOLOGY SEMESTER - III
PAPER III
POPULATION GENETICS AND EVOLUTION

Max. M.-80 **NUMBER OF UNITS: IV**

UNIT-I

1. Concepts of evolution and theories of organic evolution: Lamarckism, Darwinism and Synthetic theory of evolution
2. Evidences of evolution: anatomical, embryological, palaentological, physiological and Bio-chemical

UNIT -II

3. Hardy-Weinberg law of genetic equilibrium
4. Detailed account of destabilizing forces.
4.1 Natural selection
4.2 Mutation
4.3 Genetic drift
4.4 Meiotic drive
5. Phenotypic variation

UNIT-III

6. Patterns and mechanisms of reproductive isolation
7. Phylogenetic and biological concepts of species
8. Gene Evolution, Evolution of gene families
9. Factors affecting human disease frequency

UNIT-IV

10. Origin of higher categories
11. Micro-and Macro-evolution
12. Evolution of horse, elephant, camel, man

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

Gene & Evolution - Jha A.P. John Publication, New Delhi

Evolution & Genetics - Merrel D.J. Holt rinchert & Wiston INC.

The Genetics & Origin of Species - Dobzhansky, Columbia University Press

Evolution - Dobzhansky, Ayala F.J., Stebbins G.L. & Valentine J.M. Surjeet Publication New Delhi.

Species Evolution - The Role of Chromosomal Change - King M. Cambridge University Press.Cambridge

A Primer of Population Genetics - Hartl D.L. Suinaer Associates INC, Massachusetts

Evolutionary Genetics - Smith J.M. Oxford University Press, NewYork

Evolutionary Biology – Futuyama D.J.Suinaer Associates INC publishers, Dunderland

Evolution - Strikberger M.W. Johns & Bartett Publishers, Boston London

M. Sc. ZOOLOGY SEMESTER - III

PAPER IV

MOLECULAR CYTOGENETICS

Max. M.-80 **NUMBER OF UNITS : IV**

UNIT - I

1. Biology of chromosome
(a) Molecular anatomy of Eukaryolte chromosome
(b) Hetero - Chromatin and Euchromatin
(c) Giant chromosome - Lamipbrush & Polytene
2. Sex Chromosome, Sex Determination, sex linked inheritance and cytoplasmic inheritance
3. Linkage, crossing over & mulitiple alleles.

UNIT - II

4. Cell fusion or hybridoma - agent & mechanism of fusion.
5. Numerical and structural abnormalities of human chromosome syndrome.
6. Chromosome based heritable disease in human.

7. Life cycle o some organism important in genetic studies.
(a) Importance of knowledge of life cycles.
(b) Life cycle of Drosophila.
(c) Life cycle of Silk worm.
(d) Paramecium - Sexual & Asexual reproduction.

UNIT - III

8 Microbial Genetics.
(a) Bacterial transformation, transduction, conjugation bacterial chromosome.
(b) Baceriophages, types, structure of T4 phages and Morphogenesis.
9. Molecular cytogenetics technique .
(a) FISH, GISH.
(b) DNA finger printing.
(c) Flow cytometery.
10. Transposable element in prokarryotes and Eukaryotes, role of transposable elements in genetic regulation.
11. Gene Regulation.

UNIT - IV

12. DNA structure, type and its replication and fusion.
13. RNA structure types and function.
14. Genetic Code.
15. Protein synthesis in prokaryote and eukaryote.
(a) Transcribtion in both.
(b) Translation in both.

Suggested Reading Materials:

- Robertis, De and Robertis Cell and molecular biology Lea and Febiger.
- Watson Hopkis Roberts Steitz Weiner, Molecular Biology of the Gene the Benjamin, Cummings Publishin Company inc
- Bruce A; berts Bray ewis Raff Roberts Watson Molecular Biology of the Cell,Garland Publishing inc.
- Watson Gilman Witkowski Zoller Recombinant DNA Scientific American Books.
- Karp Gerald Cell Biology.
- Lewin B., Genes VII.
- King Cell Biology.
- Kaniel L. Hartl, Elizabeth W. Jones. Genetics Principals and Analysis, Jones and Bartlett Publishers.
- Kuby, Immunology, W.H. Freeman and Company.
- Roitt Male Snustad Immunology.
- DeRobertis and De Robertis Cell and Molecular Biology. Lea and Febiger.
- We Watson Hopking reberts steits, Weiner molecular biology of the

gene, the Benjamin / Cummings Publishin Company Inc.
- Bruce alberts, Bray, Lewis, Raff, Roberts, Watson molecular Biology of the cell garland publishing inc.
- P.K. Gupta, Molecular Cell Biology Rastogi Publication.
- Watson Gilman Witkowski, Zoller Recomdinant D.N.A. scientific American Books.
- Gerald Karp. Cell Biology.
- Lewin B. Genes VII.
- King Cell Biology.
- Baniel L. HArtl Elizabeth W. Jones, Genetics Principles and analysis . Jones and Bartlett Publisher.
- Lodish, Berk Zipursky, Matsudaira Baltimore Dernell Molecular Cell Biology W.H.Freeman and company.
- J. Travers Immunology current Biology limited.
- Kubey Immunology W.H. Freeman and Company.
- Riott, Male snustad Principles of genetics john weley and sons Inc.

M.Sc. ZOOLOGY SEMESTER -III

PRACTICAL

LAB COURSE-I

I. Comparative anatomy of Vertebrates

1. Identification, classification and study of distinguishing features of important representatives, museum specimens and slides (Protochordates and Chordates)
2. Comparative studies of integumentary, skeleton and reproductive system of major vertebrate classes.
3. Alternate methods of dissections: fowl/snake cranial nerves
4. Wonder vertebrates
5. Other exercise related to theory paper.

II. Animal Behaviour

1. To study the phototactic response in earthworm or grain/pulse pest.
2. To study the geotaxis behaviour of earthworm.
3. To study the food preference and cleaning behaviour of housefly.
4. To study the food preference in tribolium or grain/pulse pests.
5 To study the web construction and habituation in spider.
6. Estimation of body temperature and pulse rate on daily time scale.
7. Estimate the time perception among various individuals at two different time points on daily time scale.

8. Determination of effect of time on schooling behaviour in fish.
9. Toxicological response of fish opercular and surfacing activity.

Scheme of Practical Examination:

1. Alternate methods of major dissection	12 marks.
2. Alternate methods of minor dissection	08 marks.
3. Identification and Comments on spots 1 to 10	20 marks
3. Exercise based on Animal behaviour	20 marks.
4. Exercise based on Biorhythm	20 marks
5. Viva-voce	10 marks.
6. sessional	10 marks.

Total Marks 100 marks.

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M.Sc. ZOOLOGY SEMESTER -III

PRACTICAL

LAB COURSE-II

PAPER - III -Population genetics and evolution

- Problems on genetics (complete and incomplete linkage; dominance, sex-linked inheritance) Demonstration of Hardy-Weinberg law
- Preparation of human chromosomes map, demonstration of chromosomal deficiencies.
- Experiments based on population genetics, pedigree analysis.
- Study of evolution of horse by way of models.
- Study of evolution through homologous and analogous organs.
- Other exercises related to theory paper.

PAPER –IV MOLECULAR CYTOGENETIS

1. Study of mitosis from onion root tip.
2. Study of meiosis in grasshopper testis.
3. Study of polytene chromosome in Dipteran Larvae.
4. Demonstration of Barr-Body in Human Cheeck cell.
5. Estimation of DNA.
6. Estimation of RNA.
7. Measurement of cell size using oculometer.
8. Histochemical demonstration of Mitochondria

9 Histochemical demonstration of Golgi complex
10 Histochemical demonstration of Lactate dehydrogenase
11 Histochemical demonstration of Succinate dehydrogenase
12 Isolation and characterization of Nuclei from liver
13 Isolation and characterization of Mitochondria
14 Isolation of DNA from any tissue
15 Separation of lipids using thin layer chromatography
16 Separation of various proteins using column chromatography
17 Study of metaphase chromosomes from rat bone marrow
18 G banding of metaphase chromosomes
19 C- banding of metaphase chromosomes
20 Estimation of Mitotic Index
21 Other exercise related to theory paper

Scheme of Practical Examination:

1. Experiment based on Population Genetics.	20 marks.
2. Experiment based on Evolution.	20 marks.
3. Experiment based on **MOLECULAR CYTOGENETIS**.	20 marks.
4. Experiment based on **MOLECULAR CYTOGENETIS**.	20 marks.
5. Viva-voce	10 marks.
6. Sessional	10 marks.

Total Marks 100 marks.

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M. Sc. ZOOLOGY SEMESTER – IV

PAPER I

NEURO PHYSIOLOGY & HUMAN PHYSIOLOGY

Max. M.-80 **NUMBER OF UNITS : IV**

UNIT – I

Central Nervous System Gross Anatomy of Brain & Spinal Cord. Histological structure and Origin of Nervous tissue Neurons and Neuroglia & its function.

The Meninges, Neurotrophins & Cerebrospinal Fluid (CSF) and its function. Physiological Properties of nerve fibres and mechanism of conduction of Nerve Impulse in Non- medulated and medulated Nerve fibre.

Nerve endings (Bio-Analyzers) Electrical activity of Brain, EEG-Electroencephalography and its Physiological basis.

UNIT – II

Synapse – structure, Properties and its reuptake mechanism. **Neurotransmitters**: Classification, structure, receptors, function and metabolism. **Spinal cord** and the ascending descending tracks. The Cranial and spinal Nerves. **Autonomic Nervous system**: Sympathetic and parasympathetic system with special comparison to hormonal mechanism of transmission through autonomic nervous system. **Reflex action** and **sensation**.

UNIT – III

Feeding Mechanism and comparative **Physiology of Digestion**. Various digestive juices, its composition, function and mechanism of secretion. Physiology of digestion for carbohydrate, Protein, fat & Nucleic acid and its **absorption**.

Circulation of Body Fluid and its regulation. Structure of Heart. Structure, function, synthesis & composition of Blood & lymph. **Blood group** system**. Blood Coagulation** & **Defibrinisation. Cardiac cycle** and pressure and volume changes in heart and blood vessels during Cardiac Cycle. **Heart sound** and ECG.

Respiratory system and Physiology of Respiration . Structure of respiratory track. Breathing Physiology. Transport of Gases, carriage of Oxygen & Carbon di-oxide. Tissue Respiration. Respiratory diseases: Asphyxia, Hyperpnea, Anoxia etc.

UNIT – IV

Contractile elements and its Physiology. Properties of Skeletal, Smooth & Cardiac Muscle. Structure of Muscle. Ultra & Molecular Structure of Muscle. Structure of Sarcoplasmic reticulum & its role in Muscle Contraction. Theories and Physiology of muscle contraction. Changes during muscle contraction. Enzyme used in muscle contraction.

Pattern of **Nitrogen Excretion** and its Physiology. Excretory Substances. Physiology of liver for excretion. Structure of kidney and its Excretory Physiology. Fromation of Urine and Micturition. **Regulation of body temperature. Pyrexia Hypothermia**.

Suggested Reading Materials

1. The Brain : Our Nervous System by Seymour Simon
2. Mass Action in the Nervous system by Walter J. Freeman
3. Human Anatomy and Physiology with Interactive physiology 10-system Suite, 8th Edition by Elaine N. Marieb and Katja N. Hoehn (jan 10, 2010)
4. Neuroanatomy by H. G. Snell
5. Clinical Neurophysiology- Guide for Auther- Slsevier
6. Foundations of cellular Neurophysiology (Bradford Books) Daniel Johnston
7. Medical physiology by Ganong
8. Human Anatomy and Physiology by Tor Tora
9. Human Physiology by C. C. Chatterjee
10. Medical physiology by Gyaton

M. Sc. ZOOLOGY SEMESTER – IV

PAPER– II

BIOCHEMISTRY, METABOLIC REGULATION & CELL FUNCTION

Max. M.-80 **NUMBER OF UNITS : IV**

UNIT- I

Water the solvent of life, Chemistry of water, Function and regulation of water balance, General Structure of Monosaccharide, Nomenclature, Definition and Classification, Formation of Monosaccharide – Formation of glucose, Linear form , Ring form Howarth perspective format, Occurrence, Chemistry, Properties & hydrolysis of Oligosaccharides (Sucrose, Lactose, Maltose, Cellobiose, Isomaltose & Trehalose), Structure of Polysaccharides (Starch, Glycogen, Cellulose, Hyaluronic acid, Chondroitin and Heparin), Metabolism of Carbohydrate, General Structure, Classification and function of Lipids, Lipid Metabolism.

UNIT- II

Biosynthesis of Amino Acids and Structure & Properties , Chemical bond – Peptide Bond, Secondary bond – Disulfide ,Hydrogen, Non polar or hydrophobic and Ionic or, Electrostatics bond, Characteristic of Chemical bond, Protein Configuration, Primary Structure (b) Secondary Structure (c) Tertiary Structure (d) Quaternary Structure, Biological function and metabolism of Protein, Metabolism of Inorganic elements, Macro Minerals, Micro Minerals

UNIT- III

Nucleic Acid-Chemistry of DNA & RNA, Nucleo Proteins, Metabolism of Nucleic Acid (Anabolism & Catabolism), Biological importance of Nucleic Acid, Ecosanoid, Vitamin, Water & Fat Soluble Vitamin, Chemistry, Occurrence and Physiological role of Vitamins.

UNIT- IV

Enzymes-Nomenclature and Classification, Co-enzyme, Isoenzyme or Isozyme & Lysozyme , Biological role of enzyme, Properties and Characteristics of enzyme, Three Dimensional Structure of enzyme, Enzyme Inhibitors and activators, Mechanism of enzyme action, Biological Oxidation, Mitochondrial Electron Transport Chain, Oxidative Phosphorylation, Utilization of Krebs Cycle, Enzyme & Co – enzyme involved in oxidation & reduction

Suggested Reading Materials-

1. Lehninger Principles of Biochemistry, Fourth Edition

David L. Nelson, Michael M. Cox Publisher: W. H. Freeman

2. Biochemistry

Donald Voet, Hard cover: 1616 Pages Publisher: Wiley, 3rd Edition

3. Principles of Biochemistry with a Human Focus

Reginald H. Garrett, Charles M. Grisham Publisher: Brooks Cole

4. The Molecular Basis of Cell Cycle and Growth Control

Gray S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt, Publisher: Wiley-Liss

5. Experiments in Biochemistry : A Hands – on Approach Shawn o. Farrell, T. RanalloPublisher : Brooks Cole
6. Analysis of CD Effect on liver, Stomach and Intestine of Carp Fish by Hundet, A.
7. Histological and Histochemical staining techniques by Thomason
8. Biochemistory - C. L. Jain

M. Sc. ZOOLOGY SEMESTER - IV

PAPER- III

ICHTHYOLOGY

Max. M.–80 **NUMBER OF UNITS: IV**

UNIT-I

1. Skin and its derivatives in fishes.
2. Skeleton in fishes.
3. Fins-Types, structure, modification, functions
4. Locomotion in fishes and Paired Fins in fishes.
5. Food, feeding habit and alimentary canal of fishes.

UNIT-II

6. Respiration and accessory respiratory organs.
7. Swim bladder and Weberian ossicles.
8. Blood, heart and blood vascular system of fishes.
9. Excretion and Osmoregulation in fishes.

UNIT-III

10. Nervous system and sense organs in fishes
11. Specialized organs in fishes (organs of sound production & electric organs).
12. Reproduction in fishes
13. Development in fishes
14. Endocrine glands

UNIT -IV

15. Adaptation:
15.1 Colouration
15.2 Deep sea fishes
15.3 Hill stream fishes
16. Larvivorous fishes
17. Exotic fishes
18. Fish products and by-products
19. Setting and maintenance of an aquarium

Suggested Reading Materials:

Paper III & IV

- JR. Norman - The History of fishes.
- Nagaraja Rao - An introduction to fisheries.
- Lagler Ichthyology.
- Herclen Jones Fish migration.
- Marshal The life of fishes.
- Thomas - Diseases of fish.
- Greenwood - Inter relationship of fishes.
- Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.

- Brown -Physiology of fishes Vol. I & II.
- Hoar and Randall -Fish physiologyof fishes Vol. 1 & IX.
- Gunther Sterba C.N.H.-Freshwater fishes of theworld
- W. Lanharn -The Fishes.
- G.V. Nikolsky -The ecology ofFishes,
- Borgstram -Fish as food Vol. I & II.
- Nilsson -Fish physiology -Recent Advances.
- P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
- Carl E. Bond -Biology of fishes.
- M. Jobling -Environmental Biology offishes.
- Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
- S.K. Gupta -Fish and Fisheries
- K.P. Vishwas -Fish and Fishries.
- Jhingaran -Fish and Fishries.

M. Sc. ZOOLOGY SEMESTER - IV

PAPER- IV

AQUACULTURE AND FISHERIES

Max. M.–80 **NUMBER OF UNITS: IV**

UNIT-I

1. General characteristics, classification, evolution and phylogeny of the following:
Placoderms
Elasmobranchs

Holocephali
Dipnoi.
Teleostomi.

UNIT-II

2. Fish culture in fresh water
Physicochemical condition of water and its effect on fishes.
Construction and maintenance of fish farm, management of ponds
Fresh water fish breeding (dry and wet bundh breeding, induced breeding)
Stocking and transport of fish seed and brood fish.
Intensive culture of air breathing fishes.
Fish cum paddy culture.

UNIT-III

3. Composite fish culture
4. Integrated fish farming
5. Sewage fisheries
6. Prawn fishery
7. Inland fisheries
8. Marine fisheries

UNIT-IV

9. Fish diseases
9.1 Viral diseases
9.2 Bacterial and protozoan diseases
9.3 Helminth parasites of fishes
9.4 Prophylaxis and treatment of fish diseases

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Paper III & IV

- JR. Norman - The History of fishes.
- Nagaraja Rao - An introduction to fisheries.
- Lagler Ichthyology.
- Herclen Jones Fish migration.
- Marshal The life of fishes.
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- M. Jobling -Environmental Biology offishes.
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- Jhingaran -Fish and Fishries.

M.Sc. ZOOLOGY SEMESTER -IV

PRACTICAL

LAB COURSE-I (COMPULSARY)

PAPER- I NEUROPHYSIOLOGY & HUMAN PHYSIOLOGY

1. Study of slides of nervous system and other organs
2. Neck nerve of squirrel.
3. Study of Brain through MODEL.
4. Study of Cranial nerve of Bird, Amphibian, Reptile and Mammals.
5. Other exercise related to theory paper.
6. Specific Staining for various tissues & Cell organelles
7. Microtomy & Cryostats
8. Isolation and characterization of Pituitary cell
9. Estimation of MAC, MCH and MCHC
10. Total count of WBC and RBC
11. Differetial count of WBC
12. Haemoglobin estimation and PCV estimation or ESR estimation
13. Quantitative estimation of blood serum by Colorimetry (I) Blood Urea (II) Blood glucose (III) Blood Calcium (IV) Blood Creatine (V) Blood cholesterol (VI) Blood Cholesterol

(VI) Blood Protein (VII) Blood Albumin

14. Blood clotting time
15. ECG Recording
16. Blood Pressure estimation

PAPER- II BIOCHEMSTRY

- Estimation of antioxidant enzymes.
- Estimation of amylase.
- Estimation of protein by Lowry method.
- Estimation of Oil in seeds.
- Estimation of Carbohydrate by anthrone reagent.
- Other exercise related to theory paper.

17. Estimation of Protein by the Biuret, Lowry, Brad ford and Eosine-a comparasion
18. Determination of N-terminal Amino acids by the Sangers reagent (FDND)
19. Paper chromatographic separation of Amino acids
20. Quantitative estimation of Protein, carbohydrate, Mucosaccharide, Lipids and Enzyme (Bromphenol blue, PAS, Alcian blue, aldehyde fucsin, Acetylcholinestrase technique)
21. Identification of hypothalamic nuclei histological, hystochemical and Immunocytochemical method

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Ms (CR) M.Sc. III sem.	Member	

M. Sc. ZOOLOGY (SEMESTER-IV)

Practical- II

III. Icthyology

1. Study of distinguishing features, identification and classification of important species of fish available in the museum.
2. Study of fish anatomy and histology through available slides.
3. Identification of important cultivable species of fish.
4. Display of visceral organs, cranial nerves (Wallago/Mystus), breathing organs (air breathing species) and weberian ossicles (Wallago/Mystus); preparation of fish skeleton; alizarine preparation.
5. Age determination of fishes with the help of scale method.
6. Study of various hematological parameters (RBC, WBC, Hb).
7. Study of osteology of fishes.
8. Other exercises related to theory paper.

IV. Aquaculture and Fisheries

1. Estimation of hydro biological parameters- pH, conductivity, salinity, dissolved oxygen.
2. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India.
3. Study of feeding habits of fishes by gut content analysis.
4. Study of Aquarium design and maintenance.
5. Visit to fish farm/three to four day tour to study various fisheries activities at selected centers/sites.
6. Determination of gonadosomatic index.
7. Demonstration of induced breeding techniques.
8. Other exercises related to theory paper.

Scheme of Practical Examination:

1. Alternate methods of major dissection.	12 marks.
2. Alternate methods of minor dissection.	08 marks.
3. Exercise on fish hematology.	10 marks.
4. Morphometry and identification.	20 marks.
5. Experiment based on hydro biological Parameter.	10 marks.
6. Identification and Comments on spots 1 to 10	20 marks.
7. Viva-voce	10 marks

10 marks. 10 marks
8. sessional 10 marks.
Total Marks 100 marks.

APPROVED BY THE BOARD OF STUDIES

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THE END