M.Sc. Zoology

SemesterI

Paper Code	Paper Name	Code	L	T	P	Total Credits	Max Marks	External M.M.	Internal M.M.	Total Marks	Minimum Passing marks (%)
ZOO6.5AECT101	*Introduction (*Collection and preservation of animal fauna)	***AEC***	***2***	***0***	***0***	***2***					Non-CGPAS/NS*
ZOO6.5DCCT102	*Paper 1* TAXONOMY & INVERTEBRATE PHYLOGENY	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT103	Paper PAPER II: BIOLOGICAL CHEMISTRY & IMMUNOLOGY	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT104	PAPERIII:MOLECULAR BIOLOGY &CYTOGENETICS	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT105	PAPERIV: EVOLUTION	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP106	*Lab-1*	***DCC***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP107	*Lab-2*	***DCC***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
					Total Credits	***26***					
									Total Marks	***600***	

- Aggregate Passing marks are 36% in each paper.
- Each theory paper will be of 4h per week and lab work (practical) 24hrs per week (each lab of 12 h).
- Internal examination will be conducted at Institution level as per instructions and a proper record will be maintained for it, which should be posted to MGSU within a specified time.
- A board of two examiners will be formed at the Institution level for Internal Practical exams.
- A board of three examiners will be formed (at least one external examiner should be in board) for the conduction of external examination of practical. The external practical examination should be conducted in 14 hrs spreaded in two days.

- For Internal laboratory work (Practical) in each semester – Seminar and project / survey / tour should be conducted and should be considered during evaluation. The project / survey should be based on local problems and or local industry needs etc.
- There will be three sections in each theory paper Section A – 10 questions each carrying 2 mark (two questions from each unit), Section B – 5 question (two questions from each unit with an internal choice of attempting one) each carrying 6 marks, Section C - five question (one from each unit and three questions are to be attempted) each carrying 10 marks.
- S/NS*=Satisfactory or Not satisfactory.
- The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.).

PAPER I (ZOO6.5DCCT102)

TAXONOMY & INVERTEBRATE PHYLOGENY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester 1)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. A study of the classification of Invertebrates with distinguishing features and examples of various subdivisions.
2. Introduction to the science of taxonomy, rules of nomenclature.
3. Principles of classification: Theories of biological classification and their history; the species category; the polytypic species; population systematics; intraspecific categories.
4. Methods of classification: taxonomic collection and the processes of identification, taxonomic characters: types of variations (qualitative and quantitative) within a single population, methods of arriving at taxonomic divisions on species level; preparation and use of taxonomic keys.

UNIT II

1. Cytotaxonomy: Importance of cytology and genetics in taxonomy
2. Origin of Multicellularity (Protozoa,Parazoa and Metazoan)

3. Origin of Radiata (Coelenterata and Ctenophora)
4. Origin of Bilateria from Radiata (Importance of Planula larva and Ctenophores)

UNIT III

1. Criteria for phylogenetic interrelationship between Invertebrate phyla

2. Interrelationship of the Pseudocoelomate groups with special reference to Rotifera, Gastrotricha, Kinorhynca, Nematomorpha and Entoprocta.
3. Affinities and evolutionary significance of the unsegmented lesser Protostome phyla(Priapulida, Echiuroidea and Sipunculoidea, Echiurida and Sipunculida).

UNIT IV

1 Phylogenetic relationship between the coelomate phyla(Annelida, Onychophora, Arthropoda and Mollusca).
2. Affinities and evolutionary significance of the Lophophorate Colelomate phyla (Brachiopoda, Phoronida and Ectoprocta).

UNIT V

1. Phylogenetic significance of Rhynchocoela
2. Affinities of the invertebrate Deuterostome phyla(Chaetognatha, Echinodermata, Pogonophora and Hemichordata)

Suggested reading material

- Barnes, R.D. Invertebrate Zoology, W. B. Saunders Co. Philadelphia.
- Barrington, E.J.W. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd. London.
- Hyman, L. H. The Invertebrates smaller coelomate groups Vol V. Mc Graw Hill Co. NewYork.
- Hyman L.H. The Invertebrates Vol.2. McGraw Hill Co. NewYork
- Hyman, L.H. The Invertebrate Vol.8. McGraw Hill Co. NewYork and London.
- Hyman, L.H. The Invertebrates Vol.I. Protozoa through Ctenophora. McGraw Hill Co. NewYork.
- Mayer,E. Elements of taxonomy
- Russel Huntler,W.D. A biology of higher invertebrate. The Macmillan Co. Ltd.
- Simpson G.G. Principals of Animal taxonomy. Oxford IBH Publishing Company.
- Meglitsch, Schram. Invertebrate Zoology. Oxford
- Kotpal, R.L. Invertebrate phylum series(Protozoa to Echinodermata)Rastogi publication.

PAPER II (ZOO6.5DCCT103)

BIOLOGICAL CHEMISTRY & IMMUNOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks: 20 Min. Marks: 8

- **NOTE:** There will be three sections in each theory paper Section A – 10 questions each carrying 2 mark (two questions from each unit), Section B – 5 question (two questions from each unit with an internal choice of attempting one) each carrying 6 marks, Section C - five question (one from each unit and three questions are to be attempted) each carrying 10 marks.

UNIT I

1. Structure of atoms, molecules & Chemical Bonds
2. Biophysical Chemistry : Water, Acids & Bases, Buffers, Solution, Colloidal State, Viscosity, Surface Tension, Adsorption, Isotopes

UNIT II

1. **Chemistry of Carbohydrates:** definition, general properties, classification (Monosaccharides, Disaccharides, Polysaccharides) Sugar derivatives; Metabolism of carbohydrates
2. **Chemistry of Lipids:** definition, general properties and classification, fatty acids: Simple and compound lipid, Steroids, metabolism of lipids, Biomedical importance of lipids.

UNIT III

1. **Chemistry of Proteins and Amino acids:** definition, general properties of amino acids and proteins, Metabolism of proteins, Biomedical importance of proteins; Vitamins : Types and Importance

2. **Chemistry of Nucleic Acids:** Definition, general properties, classification and importance of Nucleic acids.

UNIT IV

1. **Enzymes:** Chemistry of enzymes, Nomenclature, specificity and mechanism of enzyme action. Competitive and noncompetitive inhibition, Allosteric inhibition. Kinetics, factors affecting enzyme activity,

2. **Inborn errors of metabolism**

3. Introduction and historical background of immunology, Antigens, Antibody, antibody structure and diversity

UNIT V

1. Antigen Antibody reaction, MHC, mechanism of immune response. HLA class I, II, II molecules, Humeral and cell mediated immunity,
2. Hypersensitivity reaction: type I, II, III and IV. Active and passive immunization, novel approach for various vaccines, process of vaccination,
3. Autoimmunity: Autoimmune diseases & Transplantation.

Suggested reading material

- Alberts et al. molecular Biology of the cell, Garland
- Barrington, EJW. General and comparative endocrinology. Oxford Clarendon Press.
- Bentley,P.J. Comparative Animal endocrinology, CUP.
- Hadley, Endocrinology, Prentice Hall
- Lodish et al. Molecular cell Biology, Freeman
- Martin, C.R. Endocrine physiology,OUP.
- Mathews et al. Biochemistry. Pearson education.
- Jain, J.L. Biochemistry. S, chand.New Delhi
- Voet and Voet. Biochemistry, Wiley eastern
- Lehninger, Biochemistry. CBS
- Rama Rao. A text book of biochemistry. UBSPD.
- Armstrong, F.B. biochemistry. Oxford.
- Soni, K.C. Animal physiology, CBC.Jaipur
- Stryer,L. Biochemistry. Freeman
- Cellular and Molecular Immunology: Abbas & Shiv Pillai. Elsevier Health Science
- Text Book of Immunology: K.N. Chattergee. Jaypee Brother Publications

- Essential of Immunology : Sudha Gangal & Shubhangi, University press India

PAPER III (ZOO6.5DCCT104)
MOLECULAR BIOLOGY & CYTOGENETICS

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

NOTE: There will be three sections in each theory paper Section A – 10 questions each carrying 2 mark (two questions from each unit), Section B – 5 question (two questions from each unit with an internal choice of attempting one) each carrying 6 marks, Section C - five question (one from each unit and three questions are to be attempted) each carrying 10 marks.

UNIT I

1. History and Scope of Molecular Biology

2. Detailed structure of DNA and RNA, B-DNA,Z-DNA, Topological structure of DNA, t-RNA, micro RNA

UNIT II

DNA Replication: Process and difference between Prokaryotic and Eukaryotic DNA replication. DNA and RNA polymerase, Structure and function. Accessory proteins involved in DNA replication, regulation of replication.

UNIT III

1.Protein Synthesis: Mechanism of transcription in Prokaryote and Eukaryotes. Role of sigma and Rho factor in transcription, Split gene, processing of Hn-RNA(capping, tailing and splicing)

2. Translation (Initiation complex, elongation and termination) Post and cotranslational modification

UNIT IV

1. **Gene regulation in prokaryote and Eukaryote-** Lac operon, tryo operon of E.Coli, Enhancer and silencer, Non coding gene.
2. **Molecular recombination and repair of DNA-** Holliday junction, rec A and other recombinase, Mobile genetic element (transposon). Integrons, retroposons, DNA repair (direct repair, nucleotide excision repair NER, base excision repair BER, Mismatch repair MMR).

UNIT V

1. Somatic cell genetics-cell fusion, heterokaryon

2. Imprinting of genes

3. Cell cycle. Cancer and Apotopsis (cell death), mitosis promoting factors MPF, Anaphase promoting factors APF, CDKs and cyclins, p53, oncogenes (SIS and RAS), tumour suppressor gene(TS)

Suggested reading material

- **Afherly, A.G., J.R.Girton and J.F.McDonald**. The Science of genetics. Saunders College Publishing, Harcourt Brace College, NY.

  Alberts, B., D.Bray, J.Lewis, M.Raff, K.Roberts and J.D.Watson: Molecular biology of the Cell, Garland Publishing Inc. New York.

  Braun, Robert: Introduction to Instrumental analysis, McGraw Hill International edition.

  Brooker, R.J. Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.

  Brown, T.A(Ed): Molecular Biology Lab Fax, Bios Scientific Publishers Ltd., Oxford.

  Dabre, P.D., Introduction to Practical Molecular Biology, John Wiley and Sons Ltd., New York.

  Darnell, J.H.Lodish and D. Baltimore: Molecular Cell Biology Scientific American Book, Inc.,USA.

  Fairbanks, D.J. and W.R.Anderson.Genetics- The Continuity of Life. Brooks/Cole Publishing Company ITP,NY,Toronto.

  Gardner, E.J., M.J.Simmons and D.P.Snustad. Principles of Genetics. John Wiley and Sons.Inc.NY.

  Griffiths, A.J.F., J.H. Miller,D.T.Suzuki,R.C.Lewontin and M.W.Gelbari. An introduction to genetic analysis. W,H.Freeman and Company, New York.

  John R.W. Masters Ed. Animal cell culture- A practical approach, IRL Press.

  Lewin, B. Genes.VIII to XII volume . OUP, Newyork

Meyers, R.A. Molecualr biology and Biotechnology. A comprehensive desk reference,(Ed), VCH Publishers, Inc., New York.
Sambrook, J., E.F.Fritsch and T. Maniatis: Molecular cloning: a laboratory manual, Cold Spring harbor Laboratory Press, New York.
Snustad, D.P. and M.J.Simmons. Principles of genetics. John Wiley and Sons.Inc. NY.
Watson,J.D., N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner. Molecular biology of gene, The Benjamin/Cummings Pub.Co.,Inc., California.
Wilson,K and K.H. Goulding: A biologist guide to principles and techniques of practical biochemistry. ELBS Edn.
Karp,G. Cell and Molecular biology, Wiley eastern.
Menninger. Cell structure and function. Saunder College publishing.
Primrose. Principles of gene manipulation and genomics. Blackwell
Gupta,P.K.cell and Molecualr Biology. Rastogi publication.
Rana, SVS. Biotechniques. Rastogi publications.
Soni, K.C. Modern cell biology
Soni, K.C. Biotechnology volume I to V
Wilson and Walker. Principles and techniques of Biochemistry and Molecular biology. Cambridge University press.

PAPER IV (ZOO6.5DCCT105)
EVOLUTION

Max marks 80 Min.Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

NOTE: There will be three sections in each theory paper Section A – 10 questions each carrying 2 mark (two questions from each unit), Section B – 5 question (two questions from each unit with an internal choice of attempting one) each carrying 6 marks, Section C - five question (one from each unit and three questions are to be attempted) each carrying 10 marks

UNIT I

1. Theories of evolutionary thought:
(a) Greek thought to Lamarck
(b) Darwin and theory of evolution
(c) The period after Darwin

UNIT II

1. Genetic basis of Evolution: genetic and quantitative aspects of evolution; population as a unit of evolution; gene frequency; gene pool; evolution, the result of change in gene frequency; genetic equilibrium and Hardy Weinberg Law; Mutation pressure; selection pressure; effects of population size; random and non-random reproduction; genetic drift(Sewall-Wright effect)

UNIT III

1. Isolation and its role in species formation

(i) Speciation; definition of species, sub-species and races; speciation a gradual or a sudden process. Allopatric and sympatric speciation.
(ii) Isolating mechanisms; geographical, ecological, physiological, biochemical, anatomical, developmental, behavioral, psychological and social.
(iii) Effects of Isolation: restriction of random dispersal and random mating; character displacement; reduction of fertility
(iv) Failure of isolating mechanism, gene flow, migration, Heterosis

UNIT IV

1.Variation: Somatic and germinal variations, chromosomal variations; gene mutations, rate, direction and nature of mutations, natural and induced mutations, mutagens.
2.Adaptational diversity and nature of adaptations; adaptive radiations and occupation of new environments and niches; mimicry and coloration. Ecology and evolution

UNIT V

1. Natural selection, critical evaluation of the concepts of struggle for existence and survival of the fittest; the modern concept of natural selection's adaptation and differential reproduction.
2. Neodarwinism and Neolamarckism. Characteristics of evolution: Extinction, replacement, irreversibility of specialization etc.

Suggested reading material

- Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. '
- Dobzhansky, Th., FJ. Ayala GL Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi. '
- Futuyama, DJ. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland. '
- Green, R.H. Sampling design and statistical methods for environmental biologists. John Wiley & Sons, New York. .'
- Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts. ,
- Jha, A. P. Genes and Evolution. John Publication, New Delhi.
- King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge. , '
- Lendren, D. Modelling.in behavioral ecology. Chapman & Hal, London, .UK.
- Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
  Smith, J.M. Evolutinary Gentics. Oxford University Press, New York.
- Strikberger,M.W. Evolution. Jones and Bartett Publishers, Boston London.
- Swartzman, G.L, and S.P O. Kaluzny. Ecological simulation primer. Macmillan, New York.
- Evolution by Dodson, P.W.S Publication
- Organic Evolution By V.B. Rastogi
- Theory of Evolution : Menard Smith

Semester I

Practical Work Based on Paper code 102 to 105

Day1 (ZOO6.5DCCT106)

1. **Invertebrates:** Identification,classification & study distinguishing features of important representatives from various groups' (Protozoa to Aschelminthes).
2. **Study of permanent prepared slides**(From Protozoa to Aschelminthes).
3. **Anatomy:** .

General Anatomy, Reproductive and Nervous Systems of Cockroach,Grasshopper,Craband Prawn.

4. **Premanent Preparation andTheir Study:**

(i) Preparation of cultures of Amoeba,Paramaecium and Euglena;Study of these protozoans using vital dyes. - ,

(ii) Collection and study of live Hydra, its fixation and permanent preparation.

(iii) Permanent preparations of different materials to be provided for study (Protozoa to Platyhelminthes)

5. **Biological Chemistry :**

i. Identification of Protein, carbohydrates and lipid in various tissues.
ii. Identification of different kinds of mono, di and polysaccharides in biological and chemical materials.
iii. Quantitative estimation of the following by spectrophotometer and semi autoanalyser methods in various tissues,
(a) Carbohydrates: glycogen and glucose.
(b) Proteins: total proteins.
(c) Lipid: Phospho1ipids and cholesterol.
(d) Nucleic acids: DNA and RNA. .
(e) Enzymes: acid and alkaline phosphatase.

Note:Use Of animals for dissection and practical work is subject to the conditions that these are not banned under the wildlife protection act.

DAY 2
(ZOO6.5DCCT107)

1Invertebrates:
Study of various larval stages of invertebrates (Protozoa to Aschelminthes)

2. **Anatomy:**

Identification of various local Insects upto order with the help of taxonomic keys.

3. Premanent Preparation and Their Study:

(i) Collection, fixation &permanent preparations of trematodes; cestodes & nematodes found in sheep and pig in the stool of infected persons.

(ii) Permanent preparation of various parts of dissection carried out of the animals (Protozoa to Aschelminthes)

(iii) Permanent preparations of different materials to be provided for study,

4. Cell Biology:

i. Preparation of multi-polar nerve cell from the spinal cord of a mammal.

ii. Chromosome counts in cells of the testis of an inset or mammal or cells of the bone marrow of a mammal. .

iii. Study of prepared microscopic slides, including those showing various cell types, mitosis, meiosis and giant Chromosomes. .

iv. Preparation and staining of bar bodies.

v. Squash & smear preparations of testis of cockroach and grasshopper, Acetocarmine & Fuelgen staining of these preparations.

vi. Study of mitosis in onion root tip and mammalian bone marrow cells.

vii. Study of giant chromosomes in the salivary gland of Chironomus larva and Drosophila.

viii. Vital and supra-vital staining (with neutral red and Janus Green B) of cells of the testis of an insect or mammal to study the mitochondria.

ix. RNA and DNA estimation.

5:Genetics:

i. Identification of blood groups in man.

ii. Monohybrid & Dihybrid inheritance in Drosophila.

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Semester I

Max marks 80 Min.Marks 28

Internal Assessment Max. Marks:20 Min. Marks: 8

PRACTICAL EXAMINATION SCHEME

BOARD FIRST:DAY FIRST DURATION 4 HRS

1.Exercise in Biological Chemistry 16 Marks

2.Dissection/Demonstration 16 Marks

3 Permanent preparation	08 Marks
4 Spots (5)	20 Marks
5. Viva-voce	10 Marks
6. Class record	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

BOARD SECOND:DAY SECOND DURATION 4 HRS

1.Exercise in Cell biology	14 Marks
2Exercise in Genetics	14 Marks
3.Exrecise in Taxonomy	12 Marks
4.Seminar/Field/Tour report	20 Marks
5.VivaVoce	10 Marks
6.Class record	10 Marks
Total	80 **Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

Program Structure and Examination scheme

Semester II

Paper Code	*Paper Name*	*Code*	*L*	*T*	*P*	*Total Credits*	*Max Marks*	*External M.M.*	*Internal M.M.*	*Total Marks*	*Minimum Passing marks (%)*
ZOO6.5AECT201	Introduction (Collection and preservation of animal fauna)	***AEC***	***2***	***0***	***0***	***2***					Non-CGPA S/NS*
ZOO6.5DCCT202	(Paper V)-Structure and functions in invertebrate	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT203	(Paper VI)-Animal physiology	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT204	(Paper VII)-Biotechniques & molecular evolution	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT205	(Paper VIII)-Statistical methods in biology	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP206	***Lab-1***	***DCC***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP207	***Lab-2***	***DCC***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
					Total Credits	***26***					
									Total Marks	***600***	

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- A board of three examiners will be formed (at least one external examiner should be in board) for the conduction of external examination of practical. The external practical examination should be conducted in 14 hrs spreaded in two days.
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- S/NS*=Satisfactory or Not satisfactory.
- The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.).

SEMESTER II

ZOO6.5DCCT202

PAPER V STRUCTURE AND FUNCTIONS IN INVERTEBRATE

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester II)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT-I

1. Locomotion in Invertebrate

(a) Amoeboid movements: Ultrastructure of cilia and flagella: Ciliary and flagellar movements; molecular and physiological mechanisms involved in the three kinds of movements
(b) Myotomes and muscle fibers in invertebrate structure and their involvement in locomotory action.
(c) Locomotion in relation to hydrostatics. Coelome, metamerism, arthropodization
(d) An outline of flight mechanism in insects.
2. Filter feeding in higher invertebrates; Feeding mechanisms in insects and echinoderms.
3. Respiration
(a) Respiration in lower invertebrates(Protozoans to Helminthes)
(b) Respiration In higher invertebrates(Trachea, Gills, Lungs and Lophophores)
(c) Physiology of respiratory pigments in invertebrates

UNIT-II

1. Excretion: Study of structural and functional organization of excretory systems in various invertebrate groups and a survey of various excretory products met within them.
2. Structural and functional organization of nervous systems and receptor
(a) Plan of nervous systems in the Coelenterates, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata. Structural and functional complexities of brain and ganglionic structures.
(b) Receptors: Structural and functional organization of the mechanoreceptors, chemoreceptors and photoreceptors.
3. Endocrine system: A survey of endocrinal structures and their hormones role of neurosecretions and hormones in developmental events of insects and crustaceans.

UNIT-III

1. Reproduction : Asexual and sexual reproduction met within different invertebrate groups, Parthenogenesis. Larval forms met within different invertebrate group and their significance
2. Osmoregulation and ionic regulation: Survey of principle mechanisms in fresh water, marine and terrestrial invertebrate forms.

UNIT IV

1. Parasitism: general consideration, Types of parasites, type of hosts, symbiosis and commensalism.
2. Protozoan parasites: Distribution, habit and habitat, structure life cycle and disease caused by selected pathogenic protozoan parasites of man. *Entamoeba histolytica, Trypanosoma gambiens, Leishmania donovani* and *Plasmodium vivax*.

UNIT V

1. Helminthes parasites: General characters, organization and larval forms of Platyhelminthes and nemathelminthes.
2. Distribution, habit and habitat, structure and life cycle of economically important helimnth parasites of man and domesticated animals: *Echinococus granulosus, Hymenolapsis nana, Schistosoma haematobium, Paragonimus westermani* and *Trichinella spiralis*.

Suggested reading material

- Barnes, R.D. Invertebrate Zoology, W. B. Saunders Co. Philadelphia.
- Barrington, E.J.W. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd. London.
- Hyman, L. H. The Invertebrates smaller coelomate groups Vol V. Mc Graw Hill Co. NewYork.
- Hyman L.H. The Invertebrates Vol.2. McGraw Hill Co. NewYork
- Hyman, L.H. The Invertebrate Vol.8. McGraw Hill Co. NewYork and London.
- Hyman, L.H. The Invertebrates Vol.I. Protozoa through Ctenophora. McGraw Hill Co. NewYork.
- Mayer,E. Elements of taxonomy
- Russel Huntler,W.D. A biology of higher invertebrate. The Macmillan Co. Ltd.
- Simpson G.G. Principals of Animal taxonomy. Oxford IBH Publishing Company.
- Meglitsch, Schram. Invertebrate Zoology. Oxford
- Kotpal, R.L. Invertebrate phylum series(Protozoa to Echinodermata)Rastogi publication.
- Chaterjee: Parasitology
- Chandler and Read, Introduction to Parasitology
- Noble and Noble: Parasitology
- Smith: Animal parasitology

ZOO6.5DCCT203

PAPER VI : ANIMAL PHYSIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester II)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Physiology of Digestion and Respiration

1. Mechanism of secretion and action of all types of digestive juices met within the mammalian digestive pathway, Physiological mechanisms involved in the absorption of

the end products of digestion, digestive glands and process of digestion, digestive disorders.
2. Chemistry of respiration with particular reference to mammals, respiratory path, respirator pigments, ventilation, modified forms of respiration, respiratory disorders.

UNIT II

Physiology of Circulation and Excretion

1. Blood, Physiology of blood clotting, heart, transport mechanism, nervous regulation of heart function in man, conductile and contractile mechanism of heart, cardiac cycle in man, ECG, regulatory mechanism of heart, circulatory disorders(hypertension, Hypotension, Anaemia, Myocardial infarction etc.)
2. Various nitrogenous waste products, Kidney, Architecture of nephron, role of kidney in osmoregulation, mechanism and regulation of urine formation, disorders of excretion.

UNIT III

Physiology of Muscle tissue, Nervous tissue and Receptor system

1. Morphology and functional architecture of the contractile apparatus in muscle tissue; Study of the biophysical and biochemical events underling contraction and relaxation process. Muscular disorders.
2. Biochemistry and molecular physiology of genesis, conduction of nerve impulse and transmission across synaptic junctions, neurotransmitters, reflex action.
3. General mechanism involved in stimulus transduction at receptor sites: Functional architecture and stimulus processing in eye, ear and olfactory epithelium

UNIT IV

Endocrine physiology: Cellular mechanisms of hormone action in target tissues (Hormone receptors, membrane receptors, nuclear receptors, G protein), Hypothalamic control of pituitary activity and phenomenon of neurosecretion; genesis types and general functions of hormones of various endocrine glands (Hypophysis, adrenal, thyroid, parathyroid, testis, and ovary, Islets of Langerhans).

UNIT V

Reproduction: Endocrinological control of the testicular, ovarian and uterine functions, physiological aspects of implantation and parturition and lactation. Reproductive abnormalities(Gonorrhea, Syphilis, genital herpes, prostrate problems, vaginitis, Uterine tumors, menstrual complications.

Suggested reading material

- Alberts et al. molecular Biology of the cell, Garland
- Hoar' general and comparative physiology, Prentice hall
- Lodish et al. Molecular cell Biology, Freeman
- Martin, C.R. Endocrine physiology,OUP.
- Nielson,S. Animal physiology, CUP
- Prosser and Brown. Comparative animal physiology. Satish book enterprises.
- Williams, R.H. text book of endocrinology. WB Saunders.

- Gyton,s Human physiology
- Ganongs. Review of medical physiology. Lange medical
- Vander shermann, Human Physiology. McGraw Hill
- Chaterjee, C.C. Human Physiology, Vol. I and II.
- Soni, K.C. Animal physiology, CBC.Jaipur
- Marieb. Human anatomy and physiology, Pearson education.
- Sembulungam. K.Medical physiology, Jaypee.

ZOO6.5DCCT204

PAPER VII : BIOTECHNIQUES & MOLECULAR EVOLUTION

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester II)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. **Human karyotype-** Banding techniques, Human genome, Human chromosome and genetic map, chromosomal mapping, human pedigree analysis)
2. **Molecular cytogenetics-** FISH, GISH, DNA finger printing, PD-Loop techniques, chromosomal painting, PCR, DNA chip and microarrays.

UNIT II

1. **Genome organization-** C value paradox, prokaryotic genome, viral genome and eukaryotic genome.
2. **Somatic cell genetics-** Cell fusion and hybrids agents and mechanism of fusion; Heterokaryon- selecting hybrids and chromosome segregation.

UNIT III

1. Biosensors

2. Immunological techniques based on Ag-Ab interactions, ELISA, radioimmunoassay (RIA)

3. **Separation techniques and radioisotope and mass techniques in Biology**: electrophoresis, centrifugation, MRI,

UNIT IV

1. Cryo-techniques for microscopy, Freeze dying
2. DNA sequencing and genome libraries: preparation of template DNA, Automated DNA sequencing, DNA sequence storage and analysis.
3. Animal and Human genomics: C. elegans, Drosophila genome, Mouse genome, Human genome, genome of other animals.

UNIT V

1. Molecular evolution: Concept of neutral evolution, molecular divergence and molecular clock, molecular tools in phylogeny, classification and identification, proteins and nucleotide sequence analysis; origin of genes and proteins, gene duplication and divergence.
2. Genetic evidences for modern human origins-Tracing human history through mitochondrial DNA. The Neanderthal genome , another archaic huminin genome.

- **Afherly, A.G., J.R.Girton and J.F.McDonald**. The Science of genetics. Saunders College Publishing, Harcourt Brace College, NY.
  Alberts, B., D.Bray, J.Lewis, M.Raff, K.Roberts and J.D.Watson: Molecular biology of the Cell, Garland Publishing Inc. New York.
  Brooker, R.J. Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.
  Brown, T.A(Ed): Molecular Biology Lab Fax, Bios Scientific Publishers Ltd., Oxford.
  Dabre, P.D., Introduction to Practical Molecular Biology, John Wiley and Sons Ltd., New York.
  Darnell, J.H.Lodish and D. Baltimore: Molecular Cell Biology Scientific American Book, Inc.,USA.
  Fairbanks, D.J. and W.R.Anderson.Genetics- The Continuity of Life. Brooks/Cole Publishing Company ITP,NY,Toronto.
  Gardner, E.J., M.J.Simmons and D.P.Snustad. Principles of Genetics. John Wiley and Sons.Inc.NY.
  Griffiths, A.J.F., J.H. Miller,D.T.Suzuki,R.C.Lewontin and M.W.Gelbari. An introduction to genetic analysis. W,H.Freeman and Company, New York.
  John R.W. Masters Ed. Animal cell culture- A practical approach, IRL Press.
  Lewin, B. Genes.VIII to XII volume . OUP, Newyork
  Meyers, R.A. Molecualr biology and Biotechnology. A comprehensive desk reference,(Ed), VCH Publishers, Inc., New York.
  Sambrook, J., E.F.Fritsch and T. Maniatis: Molecular cloning: a laboratory manual, Cold Spring harbor Laboratory Press, New York.
  Snustad, D.P. and M.J.Simmons. Principles of genetics. John Wiley and Sons.Inc. NY.
  Watson,J.D., N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner. Molecular biology of gene, The Benjamin/Cummings Pub.Co.,Inc., California.
  Wilson,K and K.H. Goulding: A biologist guide to principles and techniques of practical biochemistry. ELBS Edn.
  Karp,G. Cell and Molecular biology, Wiley eastern.
  Menninger. Cell structure and function. Saunder College publishing.
  Primrose. Principles of gene manipulation and genomics. Blackwell
  Gupta,P.K.cell and Molecualr Biology. Rastogi publication.

Rana, SVS. Biotechniques. Rastogi publications.
Soni, K.C. Modern cell biology
Soni, K.C. Biotechnology volume I to V
Wilson and Walker. Principles and techniques of Biochemistry and Molecular biology. Cambridge University press.

ZOO6.5DCCT205

PAPER VIII : STATISTICAL METHODS IN BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester II)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Objective and significance; important terms (Sample, Population, Variable, Types of Sampling, Data : Types of Data) ; graphs (bar diagrams, histograms, frequency polygon, line diagrams, pie diagram)
2. Frequency distribution

UNIT II

1. 1. Centering constants (Mean, Median and Mode)
2. Significance of difference in proportions:
   Correlation : Definition, types, Karl Pearson's Coefficient of Correlation, Rank Correlation
   Regression : Equations and Regression Lines
   Probability Distribution : Binomial, Poisson and Normal

UNIT III

1. Measures of variation (Standard deviation, variance, standard error of the mean)
2. F-test, t-test

UNIT IV

1.Statistical Modelling

(a) Types, Properties, and building of model
2. Chi-square test.

UNIT V

1. Analysis of variance (ANOVA)
2.Computer application in zoological study; software used in biomedical sciences (Image analysis, system automation)

- Ball, Marion J.: What is a computer?, Honghton Mifflin Company, Boston, Massachusetts, 1972 '
- Batschelet, E. Introduction to mathematics for life scientists. SpringerVerlag, Berlin. '
- Brightman' Richard W. and Jeffrey M Dimsdale: Using microcomputer, Galgotia Publication Pvt. Ltd., 1987
- Desmonde, William H: Computers and their uses, Prentice Hall, Inc., Englewood Cliffs; New Jersey, 1964
- Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. '
- Dobzhansky, Th., FJ. Ayala GL Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
- P.S.S.Sundar Rao & J. Richard : Introduction to Biostatistics, PHI Learning Pvt Ltd
- N. Arumugam : Basic concepts of biostatistics , Saras Publications
- P.K.Banerjee : Introduction to Biosatistics, S. Chand
- W.W.Daniel & C.L.Cross : Biostatistics, Wiley Publications
- B. Antonisamy : Principles and Practice of Biostatistics , Elsvier Publications '

SEMESTER II

Practical Work Based on Paper V to VIII (202 -205)

Day I (ZOO6.5DCCT206)

1 Invertebrates:

(i) Identification, classification & study distinguishing features of important representatives from various groups (Molluscans and Echinodermates).
(ii) Study of permanent prepared slides (Molluscans and Echinodermates)

(ii)Preparation of culture of Invertebrates with special reference to protozoans, poriferans Arthropods and Worms .
(iii) Study of sections of the arm of a starfish; water vascular system of starfish; general anatomy of a holothurian; Aristotle's lantern of a sea-urchin: complete as well as disarticulated arrangement of the parts of Aristotle's lantern.

2.Anatomy: .
(ii) Nervous system and general anatomy of Patella, Lamellidens, Mytilus, Sepia, Loligo, Octopus and Aplysia.

3.Premanent Preparation and Their Study :
(i)Permanent Preparation of different mounting material (Lower invertebrates.)

4. Physiology I:

i. Recording of Electrocardiogram, Muscle twitch, heart beat & the study of the effect of electrical stimulation, various ligatures, drugs, etc. through Computer simulation

ii.Estimation of blood pressure(Diastolic and Systolic).

iii. Photometric determination of haemoglobin in blood sample.

Iv Determination of blood urea value.

5. Statistical Methods in Biology:

i Preparation of frequency tables and graphs.

ii.). Preparation of histogram, bar diagram and Line graph using computer.

iii)Calculation of standard deviation, variance and standard error of the mean. .

iv). Plotting the slope of a line on a graph, calculations of the slope of a line, regression coefficient. '

v) Coefficient of Correlation

vi) Use of t -test.

vii. Use of Chi-square test.

Students shall have to maintain a complete record of the work done.

Note: Use Of animals for dissection and practical work is subject to the conditions that these are not banned under the wildlife protection act.

SEMESTER II Practical Work Based on Paper V to VIII (202-205)

DAY 2 (ZOO6.5DCCT207)

1 Invertebrates:

(i) Identification, classification & study distinguishing features of important representatives from various groups.(Annelida and Arthropoda)

(ii) Study of permanent prepared slides (Annelida and Arthropoda)

2.Biotechniques: . - .

i). Paper chromatography and thin layer chromatography:- uni-dimensional chromatography, using amino acids from purified samples and biological materials.

II). Paper electrophoresis and Gel (SDS page and Agarose) electrophoresis; Determination of serum protein through paper and gel (SDS and Agarose electrophoresis)

3. Physiology II:

i.Preparation of thick and thin blood film smear.

ii. Study of PBF (Peripheral blood film).

iii.Eosinophil count in given/ own blood sample.

iv. Demonstration of the following in blood: clotting time, erythrocyte sedimentation rate , haemolysis and crenation

v. Enzyme activity of LDH and SDH

4:Permanent Preparation:
Permanent Preparation of different mounting material (Higher invertebrates.)

Note: Use Of animals for dissection and practical work is subject to the conditions that these are not banned under the wildlife protection act

Semester II

PRACTICAL EXAMINATION SCHEME

Max marks 80 Min.Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

BOARD FIRST: DAY FIRST	DURATION 4 HRS
1. Dissection/ Demonstration	12 Marks
2. Exercise in Physiology I	12 Marks
3. Exercise in Statistics	12 Marks
4. Permanent preparation	16 Marks
5. Spot	08 Marks
6.Viva-voce	10 Marks
7. Class record	10 Marks
Total	**80** Marks
Internal Assessment	**20** Marks
Grand Total	**100 Marks**

BOARD SECOND: DAY SECOND	DURATION 4 HRS
1. Exercise in Physiology II	20 Marks
2 Permanent preparation	16 Marks
3 Exercise in Biotechniques	16 Marks
4. Spot	08 Marks

5. Viva Voce	10 Marks
6. Class record	10 Marks
Total	80 **Marks**
Internal Assessment	**20 Marks**
Grand Total	**100 Marks**

- ***M.Sc. Zoology : Program Structure and Examination scheme***

Semester III

Paper Code	***Paper Name***	***Code***	***L***	***T***	***P***	***Total Credits***	***Max Marks***	***External M.M.***	***Internal M.M.***	***Total Marks***	***Minimum Passing marks (%)***
ZOO6.5AECT301	Demonstration & Practical Training in Life Science	***AEC***	***2***	***0***	***0***	***2***					Non-CGPA S/NS*
ZOO6.5DCCT302	(Paper IX) Chordata	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT303	(Paper X) Animal behavior	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT304A or B or C or D ***(choose only one from A/B/C/D)****	Paper XI A1/B1/C1/ D1	***DSE***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT305AorB orCorD ***(choose only one from A/B/C/D)****	Paper XI A2/B2/C2/ D2	***DSE***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP306	***Lab-5***	***DSE***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP307 A or B or C or D ***(choose only one from A/B/C/D)****	***Lab-6 (A/B/C/D)***	***DSE***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
		Total Credits				***26***					
									Total Marks	***600***	
									Grand Total of Credits (all four semesters)	***104***	
									Grand Total of Marks (all four semesters)	***2400***	

A*.Cell Biology **B***.Environmental Biology **C***.Entomology **D***.Fish Biology

- Aggregate Passing marks are 36% in each paper.
  - For DSE students are allowed to select a group of their choice i.e. A/B/C/D

- Each theory paper will be of 4h per week and lab work (practicals) 24hrs per week (each lab of 12 h).
- Internal examination will be conducted at Institution level as per instructions and a proper record will be maintained for it, which should be posted to MGSU within a specified time.
- A board of two examiners will be formed at the Institution level for Internal Practical exams.
- A board of three examiners will be formed (at least one external examiner should be in board) for the conduction of external examination of practical, The examination should be conducted in 14 hrs spreaded in two days.
- For Internal laboratory work (Practical) in each semester – Seminar and project / survey / tour should be conducted and should be considered during evaluation. The project / survey should be based on local problems and or local industry needs etc.

- There will be three sections in each theory paper Section A – 10 questions each carrying 2 mark (two questions from each unit), Section B – 5 question (two questions from each unit with an internal choice of attempting one) each carrying 6 marks, Section C - five question (one from each unit and three questions are to be attempted) each carrying 10 marks.
- S/NS*=Satisfactory or Not satisfactory.
- The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.).

Semester III

ZOO6.5DCCT302

PAPER IX: CHORDATA

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C

- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Origin and outline classification of the chordates (Pisces to Mammals)
2. Interrelationships of Hemichordata, Urochordata and Cephalochordata and their relations with other Deuterostomes.
3. Life histories of sessile and pelagic tunicates and ascidian, Pyrosoma, Salpa, Doliolum and Oikopleura

UNIT II

1. Origin, evolution and adaptive radiation of vertebrates.
(a) Geological time scale and fossils
(b)Origin, evolution and general characters of Agnatha (Ostracoderms and Cyclostomes).
(c) The early gnathostome (Placodermi)
(d) A general account of the elasmobranchi, Holocephali, Dipnoi, Crossopterygi
(e) Adaptive radiation in bony fishes.
2. Origin, evolution and adaptive radiation of Amphibia

UNIT III

1. Origin and evolution of reptiles: the concept of land Seymouria and related forms: Cotylosauria, basic skull types and outline classification of reptiles.
2. Dinosaurs, types and evolutionary significance
3. Living reptiles- a brief account of Rhynchocephalia. Chelonia, Crocodilia and Squamata

UNIT IV

1. Origin and evolution of birds
2. Origin of flight: flight adaptations
3. Origins of mammals: Primitive mammals (Prototheria and Metatheria)

UNIT V

1. A general survey of the main radiations in eutherian mammals (excluding detailed reference to individual order)
2. Evolution of man: relationship of man with other Primates: fossil record of Man's ancestry.

Suggested reading material

- Chordate Zoology E.L. Jordan & P.S. Verma S. Chand Publishing
- Chordate Embryology P.S. Verma & V.K. Agarwal S. Chand Publishing
- Vertebrate Zoology R.L. Kotpal Rastogi Publications
- Chordate Zoology and Animal Physiology S.S. Lal Rastogi Publications
- Modern Textbook of Zoology: Vertebrates R.L. Kotpal Rastogi Publications
- Chordate Zoology M. Ekambaranatha Ayyar Viswanathan (Printers & Publishers)
- A Textbook of Zoology: Vertebrates A.K. Sinha, S. Kumar, N.K. Verma S. Chand Publishing

- Biology of Chordates E.L. Jordan & P.S. Verma S. Chand Publishing
- Comparative Anatomy of Vertebrates S.K. Tiwari Vikas Publishing House
- Chordate Zoology (Invertebrate + Vertebrate) R.L. Kotpal Rastogi Publications

ZOO6.5DCCT303

PAPER X : ANIMAL BEHAVIOUR

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Introduction to animal behavior
2. Behaviour of domestic and zoo animals
3. Orientation : Classification of various types of taxes and kineses.
4. Methods of studying behaviour: Brain lesions; electrical stimulation, drug administration. Effect of toxins, drugs and alcohol on human behaviour and addiction.

UNIT II

1. Types of behaviour and their regulation:
(i) Components of feeding behaviour, hunger drive, directional movement, avoidance, eating, carrying and hoarding
(ii)Factors influencing choice of food
(iii) Nervous regulation of food and energy intake
(iv) Motivated behaviour, Drive, satiation and neuro-physiological control
(v) Feeding behaviour

UNIT III

1. Learning: Habituation conditioned reflex: trial and error, latent learning, learning and discrimination, imprinting, neural mechanism of learning.
2. Instinctive behaviour; concept, phyletic descent and physiology

3. Hormones and behaviour, Mammalian nervous system with special reference to the involvement of hypothalamus in the regulation of behavioural patterns

UNIT IV

1. Social behaviour in Primates
(a) Primate societies
(b) Social signals, olfactory, tactile, visual, vocal
(c)Status: Dominance and hierarchy territorial behaviour courtship and mating aggression.
2. Behaviour in birds: Behaviour of Streptopelia (ring dove); homing and migration

UNIT V

1. Reproductive behaviour in fish(Stickle back or any other fish)
2. Social behaviour in insects: Communication; concealment behavior; Role of pheromones (A general account)
3. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual, genetics and human behavior

Suggested reading material :

- Animal Behaviour Dr. Reena Mathur Rastogi Publications, Meerut
- Principles of Animal Behaviour V.K. Agarwal S. Chand Publishing
- Essentials of Animal Behaviour R.S. Mehta Dominant Publishers, New Delhi
- Animal Behaviour (Ethology) M.P. Arora Himalaya Publishing House
- Textbook of Animal Behaviour M. Rajalakshmi Neelkamal Publications
- Animal Behaviour and Chronobiology A.S. Deol & P. N. Srivastava Narosa Publishing House
- Ethology and Animal Behaviour N. Arumugam & V. Kumaresan Saras Publication
- Concepts of Animal Behaviour R.L. Kotpal Rastogi Publications, Meerut
- Animal Behaviour S.K. Kulshreshtha Kalyani Publishers
- Behavioural Biology G.K. Bhatia Surjeet Publications, Delhi

PRACTICAL WORK BASED ON CHORDATA & ANIMAL BEHAVIOUR
ZOO6.5DCCT302 & ZOO6.5DCCT303

Max Marks 80 Min. Marks 28
Internal Assessment Max. Marks : 20 Min. Marks 8

1. Chordates

(a) Taxonomy: Study of museum specimens or representative, animals from all chordate groups (protochordates to mammals).

(b) Anatomy (Models, Charts, Computer simulation):

(i) General anatomy and neural gland of Herdmania.
(ii) Afferent and efferent arteries, cranial nerves of any commercial fish.
(iii) Accessory respiratory organs of fishes
(iv) Limb musculature, cranial nerves and eye muscles and their innervations in frog,
(v) General anatomy, major blood vessels and cranial nerves of any nonpoisonous snake.
(vi) Study of differences between poisonous and non-poisonous snakes.
(vii) Flight muscles, perching mechanism, air sacs and anatomy of the neck region in the pigeon.
(vii) Reproductive system and anatomy of the neck region in rat.
(viii) General anatomy, digestive, respiratory and urinogenital systems in chick

(c) Permanent Preparations: Spicules and pharyngeal wall of Herdmania, velum and pharyngeal wall of Amphioxus. Whole mounts of pelagic tunicates, ampulla's of Lorenzini in a skate or ray; Different types of scales, ear ossicles of fish or any other animal.

(d)Histology: A detailed study of the histology of all mammalian tissues and organs through prepared slides to be made available .

2. Ethology:

(a) Study of the process of learning in rat with the help of animal maze, analysis of the results of simple experiments.
(b) Study of the shock and avoidance behaviour in rat including extinction and relearning; analysis of the result of these experiments
(c) Chemical communication in the earthworm
(d) Study of the food preferences and feeding behaviour of an insect pest.
(e) Study of the phototactic response in Tribolium/Housefly
(f) Study of habituation in chicks.

3. **Osteology**:

Comparative study of the axial and appendicular skeleton from amphibia to mammals, with particular reference to important skull types in reptiles, birds and mammals.
Alizarins and Victoria-blue preparation of the skeleton of any vertebrate, dried and articulated preparation of the skeleton of any vertebrate.

4. Zoological tour

Tour is compulsory for all the candidates to observe and study fauna in natural habitat.
(Note - use of animals for dissection/practical work is subject to the conditions that these are not banned under the Wild Life Protection Act and UGC guidelines.)

ZOO6.5DCCT304A

PAPER XI(A 1): CELL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1**.** Concept of cell theory and historical development in cell biology
2. **Cell types**: detailed structure of the structure of the different types of cells
(i) Nerve cell (ii) Muscle cell (iii)Gland cell (iv) Blood cell

UNIT II

Membrane structure and function: various models of Plasma Membrane, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes

UNIT III

Structural organization and function of intracellular organelles:
(i). Cell wall, nucleus, mitochondria, golgi bodies,
(ii). Lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility

UNIT IV

Cell division and cell cycle: Types of cell divisions and their regulation, control of cell cycle Physiological study of mitotic and meiotic divisions with special reference to the mechanism of chromosome movement and organization of the spindle apparatus, mitotic poisons and their actions

UNIT V

Gametogenesis : Spermatogenesis , Ogenesis & Fertilization including their mechanism and physiology

ZOO6.5DCCT305A

PAPER XI(A 2): CELL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Chromosomes: Structural, chemical and functional organization of the different types of chromosomes (giant chromosomes, supernumerary chromosomes), Chromosomal aberration

UNIT II

1. **Gene organization:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

2. Cell Signalling : Hormones & their receptors, Signalling through G-Protein coupled receptors, Signal Transduction Pathways, Second Messengers.

UNIT III

Cell Communication : General Principles of Cell Communication, Cell adhesion & Role of Different Adhesion Molecules, Gap Junctions, Extra cellular Matrix, Integrins, Neurotransmissions and its Regulations.

UNIT IV

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth

UNIT V

Apoptosis : Extrinsic and Intrinsic pathways, Necrosis, Autophagy, Apoptosis in C elegans.

Suggested reading material:

- P.S.Verma : Cell Biology, Genetics, Molecular Biology. S.Chand
- PK Gupta : Cell and Molecular Biology, Rastogi Publications
- Nisha Tiwari, Sanjay Kumar Panda: Cell and Molecular Biology. Thakur Publication Private Limited
- E D P De Roberties, E M F De Roberties: Cell and Molecular Biology, B.I. Waverly Pvt. Ltd.
- Garald carp :Cell biology, Willey
- Bruce Alberts: Molecular biology of the all , WW Norton and Corporation
- Geoffrey M Cooper: The cell : a molecular approach, Sinauer Associates Inc.
- S.Kannan: Cell and Molecular Biology, MJP Publishers
- Harvey Lodish: Molecular cell biology
- Philip Sheeler:Cell and Molecular Biology, Wiley, W.H.Freeman & Co. Ltd

CELL BIOLOGY PRACTICALS FOR ZOO6.5DCCT304A & ZOO6.5DCCT305A

Max Marks 80 Min. Marks 28
Internal Assessment Max. Marks : 20 Min. Marks 8

1. Handling and operation of following apparatus and equipments:
(a) Phase Contrast Microscope
(b) Electrophoretic, Chromatographic and electrophysiological equipments
2. Microtomy - Wax, fresh, frozen and fixed frozen sections
3. Study of stained preparations of mitochondria and golgi bodies under the light Microscope
4. Biochemical estimations of the 'following in various tissues:
(a) Lipids: Cholesterol
(b) Carobhydrates: Glycogen, Blood Glucose
(c) Proteins
(d) Amino acids: chromatographic and electrophoretic separation
(e) Ascorbic acid
5. Preparation of Karyotype in animal tissue
6. Field visit to Centres of research for knowledge of different instruments, artificial insemination etc. and preparing field report
7. Spotting :
(a). Study of Different stages of Mitosis
(b). Equipments used in Cell Biology

ZOO6.5DCCT304B

PAPER XI (B 1): ENVIRONMENTAL BIOLOGY

Max marks 80 Min. Marks 28

Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Concepts and Scope Environmental Biology, Earth, man and environment.
2. The earth systems and Biosphere: Conservation of matter in various geospheres- lithosphere, hydrosphere, atmosphere and biosphere. Climates of India.
3. Change impact on air quality investigating the effect of climate change on air quality, change in pollutant concentrations.
4. Atmospheric blocking studying the causes, effect and role of blocking including its role in weather patterns and climate variability.

UNIT II

1. Impact of environment at cellular level: Cellular interaction with environment with special reference to pH, light, temperature and salinity.
2. Environmental Physiology: Ecophysiological adaptations with special reference to desert, high attitudes lotic, marine environment

UNIT III

Hibernation and aestivations. Poikilo-therms and Homeotherms. Response to temperature and pressure. Thermal properties of water and survival limits. Acclimatization.

UNIT IV

1.A detailed study of different ecosystems: Study will include Abiotic and biotic components and their interrelationships, productivity and adaptations of animals.

Terrestrial ecosystems: Grasslands, including grazing lands.
2.A detailed study of different ecosystems: Study will include Abiotic and biotic components and their interrelationships, productivity and adaptations of animals.
Forests: Characteristics of alpine, temperate and tropical forests.

UNIT V

Stratification. High altitude with special reference to Himalayan Ecology.
Deserts: Types and ecological attributes of desert biota.
Taiga: Extent and ecological peculiarities and its biota
Tundra: Extent and ecological peculiarities and its biota

ZOO6.5DCCT305B

PAPER XI (B 2): ENVIRONMENTAL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Aquatic Ecosystems :
Fresh water: Lakes including salt lakes, ponds streams, springs, rivers and marshes.

UNIT II

Marine ecosystem: Zonation, fauna.
Estuarine: Ecological peculiarities, adaptations including impact on fauna.

UNIT III

Major biogeographic (zoogeographic and phytogeographic) regions of the world and India, extent, characteristics and species composition.

UNIT IV

Development and evolution of ecosystems, causes and kinds of succession. Diversity and productivity in relation to stages of succession and development.

UNIT V

Urban, rural and other man made ecosystems their impact on flora and fauna, socio-ecological impacts of urbanization and industrialization.

Suggested reading material :

- P.S. Verma and V.K.Agarwal: Principles of Ecology, S.Chand Pulbicaltion
- E.G.P. Odum: Fundamnetals of Ecology
- S.V.S. Rana: Essential of Ecology and Environmental Science, Phi New Delhi
- K.C. Agrawal: Environmental Biology, Nidhi Publisher
- R.S. Rana: A textbook of Environmental Ecology, Khanna Publication, New Delhi
- S.V. Kumar: Modern concept of Ecology, Vikas Publications
- Taylor and Miller: Environmental Science,Cengage Learning Publication
- Ditta: Ecology and Environment, Pearlson Pulbication

ENVIRONMENTAL BIOLOGY PRACTICALS FOR ZOO6.5DCCT304B & ZOO6.5DCCT305B

Max Marks 80 Min. Marks 28
Internal Assessment Max. Marks : 20 Min. Marks 8

1. Water quality analysis (Physico- chemical parameters).

(a) Temperature	(b) pH	(c) Dissolved oxygen
(d) Acidity	(e) Hardness	(f) Alkalinity
(g) Chlorides.	(h) Sulphates	(i) Total dissolved solids
(j) BOD	(k) COD	

2. Microscopic examination of water: Indicators of pollution, Phytoplanktons and littoral fauna and flora and slide preparation of phytoplankton.
3. Bioassays of polluted waters using fish or other aquatic organisms.
4. Spots:- Local Fauna

5. Sampling procedures and report on a case study.
6. Statistical Analysis : Grouping of data and preparation of frequency distribution. Histogram and frequency polygon; Calculating mean, median and mode for grouped and ungrouped data; Calculating standard deviation for grouped and ungrouped data; Fitting simple linear regression.

(Students are Supposed to give complete ecological report of the trip)

ZOO6.5DCCT304C

PAPER XI (C 1): ENTOMOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

History of Entomology: A general idea of fossil insects, evolution of insects; Insect classification (up to orders and suborders).

UNIT II

Detailed classification of important and selected super families and families of the following orders of economic importance: Orthoptera, Isoptera

UNIT III

Detailed classification of important and selected super families and families of the following orders of economic importance: Homoptera, Hemiptera

UNIT IV

Detailed classification of important and selected super families and families of the following orders of economic importance: Lepidoptera, Diptera

UNIT V

Detailed classification of important and selected super families and families of the following orders of economic importance: Coleoptera and Hymenoptera

ZOO6.5DCCT305C

PAPER XI (C 2): ENTOMOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Insect morphology: Head, thorax, abdomen and their appendages ; Integument

UNIT II

Functional organization of Muscular, digestive, circulatory systems

UNIT III

Functional organization of respiratory, excretory, reproductive systems

UNIT IV

Functional organization of Nervous and endocrine systems; sense organs, sound and light producing organs.

UNIT V

Embryology: Structure of a typical insect egg, types of metamorphosis met within insects, development: embryonic and post embryonic, diapause.
Suggested reading material :

- Text book of entomology. a d AIMS. Springer CBS publisher
- General and applied entomology: KC Choudhary. Ahsan publishing house

- Principal of insect morphology: RE Snodgrass. Cornell University Press
- Introduction to insect: Borror Triplehorn & Johnson Saunders. college publishing
- Modern entomology : D B Tembhare. Himalaya publishing house
- Applied entomology: PD Srivastava. Kalyani publishers Delhi
- Insect Ecology and integrated paste Management : Dhaliwal and Arora .Kalyani publisher
- Handbook of practical Entomology : Meera Srivastava. Surya Prakashan Mandir Bikaner
- Agriculture insect paste and their control: V B Awasthi .scientific publisher Jodhpur
- Entomology Ecology and behaviour: PJ Gullan and Cranston. Wiley blackwell publisher
- Biological control of insect paste : TV Sathe .Daya publishing house
- Aadhunik keet Vigyan: B L Jat. Rita Publication Agra
- A manual of practical Entomology: volume first and second Ghosh & Sen. Emkay Publication
- Fundamentals of applied Entomology : RT Cotton. macmillan Publisher

ENTOMOLOGY PRACTICAL BASED ON ZOO6.5DCCT304C & ZOO6.5DCCT305C

Max Marks 80 Min. Marks 28
Internal Assessment Max. Marks : 20 Min. Marks 8

1. Knowledge and use of equipment for the collection and preservation of insects, insect net, killing bottle, spreading board, insect box device for inflating larva, light trap, etc.
2. Collection and preservation of insects and their different stages.
3. Collection of seasonal insects, nocturnal insects, aquatic insects, crop pests, stored grain pests and insects of medical and veterinary importance.
4. Identification of insects families from various orders prescribed for study in the syllabus. .
5. Permanent preparations: wings, mouth parts, antennae, legs, spiracles, sting etc. of insects.
6. A visit to local farm houses/ gardens for study of various pests of vegetables and crops.

ZOO6.5DCCT304D

PAPER XI (D 1): FISH BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)

- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

General account and phylogenetic significance of ostracoderms and placoderms.

UNIT II

Classification of fishes, with distinguishing characters of the principal subdivisions.

UNIT III

1.Origin and adaptive radiation of various groups.

2. Geographical distribution

UNIT IV

1.Body form and locomotion

2. Integument and exoskeleton

UNIT V

1. Structure, modification and functions of fins
2. Theories of origin of median and paired fins

ZOO6.5DCCT305D

PAPER XI (D 2): FISH BIOLOGY

Max marks 80 Min. Marks 28

Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester III)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks

- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1.Endoskeleton
2. Musculature

UNIT II

1. Food & alimentary canal, physiology of digestion.
2. Blood vascular system and circulation of blood

UNIT III

1. Respiratory organs, physiology of respiration and regulation of breathing, air-breathing organs.
2. Structure, function and physiology of the swim bladder.

UNIT IV

1.Weberian apparatus.
2. Excretory organs and the physiology of excretion, Osmoregulation.
3 .Nervous system and sense organs.

UNIT V

Endocrine glands, hormones & reproductive behaviour, gonads, reproduction development and hatching, viviparity

Suggested reading material :

- A text book of Fish Biology and Fisheries : S.S.Khanna & H.R.Singh, Narendra Publishing House
- Hand book of Fish and Fisheries : R.K.Sinha, Agrotech Press
- Biology of Fishes : Richard Moore & Quentin Bone, Taylor & Franscis Ltd.
- Biology and Ecology of Fishes, Diana John Wiley
- Fish and Fisheries of India : Pandey , Rastogi Publications

FISH BIOLOGY PRACTICAL BASED ON ZOO6.5DCCT304D & ZOO6.5DCCT305D

Max Marks 80 Min. Marks 28
Internal Assessment Max. Marks : 20 Min. Marks 8

1. Dissection/demonstration:
Complete anatomy of a teleost, represented by *Wallago* or any other locally available fish: external features. General viscera; including the urinogenital organs, jaw and lateral musculature,

including the nerve supply, afferent and efferent branchial blood vessels, brain and cranial nerves; eye muscles and their innervation; membranous labyrinth, Weberian ossicles- swim bladder connection, dry and alizarin preparations of the skeleton
and its study
2.Study of breathing organs in a fish of commercial use (*Channa* and *Heteropneustes* or any cat fish).
3. (a). Periodical visits to a local fishing farm of fish centre to gain a first hand knowledge of its pisciculture practices and fisheries activities
(b. A week's tour of an inland fisheries research station of Pisciculture centre. The suggested places for the tour are Udaipur;-RanaPratap Sager Dam at Kota, Alwar, Bhartapur, Allahabad, Cuttack and Barrackpore
Note: A record of the work done under 3 Items has to be compulsorily submitted by each candidate.
(Note: Use of animals for dissection/practical work is subject to the conditions that these are not banned under the wild life protection act and UGC guidelines.)
4. External features, cranial nerves and membranous labyrinth of any ray.
5. Permanent preparations and study of different scales.
6. Spotting based on Museum Specimens Elasmobranchii, Dipnoi & Holocephali
7. Study of disarticulated bones of any bony fish.

SEMESTER III
(Duration 4h)
SCHEME OF PRACTICAL EXAMINATION AND DISTRIBUTION OF MARKS

Day 1 (**ZOO6.5DCCT306)**
General Chordates and Ethology

(a) Chordate's major dissection/demonstration	10 Marks
(b) Permanent preparation/Microtomy	10 Marks
(c) Exercise in Ethology	10 Marks
(d) Tour Report	10 Marks
(e) Identification and comments of spots (5)	20 Marks
(f) Viva- voce	10 Marks
(g) Class Record	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

Day 2 (ZOO6.5DCCT307 A/B/C/D)
(Special paper)
(A) Cell Biology

(a) Exercise histo-chemical or cyto-chemical techniques in tissue	14 Marks
(b) Isolation of DNA	10 Marks
(c) Light Microscopic Preparation of spermatozoa/ Meiotic Chromosome Study	10 Marks
(d) Spot	16 Marks
(e) Project /Field report	10 Marks

(f) Viva- voce	10 Marks
(g) Class Record	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

(B)Environmental Biology

(a) Water analysis	14 Marks
(b) Microscopic Examination of water and slide preparation(Phytoplankton)	10 Marks
(c) Bioassay method/Statistical method	10 Marks
(d Spots (4)	16 Marks
(e) Project report (Case Study)	10 marks
(f) Viva- voce	10 Marks
(g) Class Record	10 marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

(C) Entomology

(a) Identification of 3 insects using taxonomic key	18 Marks
(b) Permanent preparation	08 Marks
© Study of Pests	08 Marks
(d) Spots (4)	16 Marks
(e) Project/Field Report	10 Marks
(f) Viva- voce	10 Marks
(g) Class Record	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

(D) Fish Biology

(a) Major Dissection/ demonstration	12 Marks
(b) Minor dissection/demonstration	08 Marks
(c) Permanent preparation	10 Marks
(d) Identification and comments on Spots (5)	20 Marks
(e) Viva-voce	10 Marks
(f) Class Record	10 Marks
(g)Field Report	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

- ***M.Sc. Zoology : Program Structure and Examination scheme***

Semester IV

Paper Code	***Paper Name***	***Code***	***L***	***T***	***P***	***Total Credits***	***Max Marks***	***External M.M.***	***Internal M.M.***	***Total Marks***	***Minimum Passing marks (%)***
ZOO6.5AECT401	Demonstration & Practical Training in Life Science	***AEC***	***2***	***0***	***0***	***2***					Non-CGPA S/NS*
ZOO6.5DCCT402	(Paper XII) Developmental biology	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT403	(PaperXIII) Animal ecology	***DCC***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT404A or B or C or D ***(choose only one from A/B/C/D)****	PaperXIV A1/B1/C1/D1	***DSE***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCT405AorBorCorD ***(choose only one from A/B/C/D)****	Paper XIV A2/B2/C2/D2	***DSE***	***3***	***1***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP406	***Lab-5***	***DSE***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
ZOO6.5DCCP407 A or B or C or D ***(choose only one from A/B/C/D)****	***Lab-6 (A/B/C/D)***	***DSE***	***0***	***0***	***4***	***4***	***100***	***80***	***20***	***100***	***36***
					Total Credits	***26***					
									Total Marks	***600***	
									Grand Total of Credits (all four semesters)	***104***	
									Grand Total of Marks (all four semesters)	***2400***	

A*.Cell Biology **B***.Environmental Biology **C***.Entomology **D***.Fish Biology

- Aggregate Passing marks are 36% in each paper.

- For DSE students are allowed to select a group of their choice i.e. A/B/C/D
- Each theory paper will be of 4h per week and lab work (practicals) 24hrs per week (each lab of 12 h).
- Internal examination will be conducted at Institution level as per instructions and a proper record will be maintained for it, which should be posted to MGSU within a specified time.
- A board of two examiners will be formed at the Institution level for Internal Practical exams.
- A board of three examiners will be formed (at least one external examiner should be in board) for the conduction of external examination of practical, The examination should be conducted in 14 hrs spreaded in two days.
- For Internal laboratory work (Practical) in each semester – Seminar and project / survey / tour should be conducted and should be considered during evaluation. The project / survey should be based on local problems and or local industry needs etc.

- There will be three sections in each theory paper Section A – 10 questions each carrying 2 mark (two questions from each unit), Section B – 5 question (two questions from each unit with an internal choice of attempting one) each carrying 6 marks, Section C - five question (one from each unit and three questions are to be attempted) each carrying 10 marks.
- S/NS*=Satisfactory or Not satisfactory.
- The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.).

SEMESTER IV

ZOO6.5DCCT402

PAPER XII : DEVELOPMENTAL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Theories of Development. Preformation and Epigenesis
2. Oogenesis
(a) Growth of oocyte and Vitellogenesis
(b) Organization of egg cytoplasm; role of the egg cortex:
(c) Morphogenetic determination in egg cytoplasm.
Spermatogenesis
3. Fertilization; significance of fertilization for development and the essence of activation of the egg.
4. Early embryonic development:
(a) Patterns of cleavage, blastulation & gastrulation in chordates (Tunicates to mammals).
(b) Fate maps.
(c) Morphogenetic movements.
(d) Mechanics and significance of gastrulation.

UNIT II

1. Causal basis of development: Primary embryonic induction:
(a) Concepts of potencies; prospective fates; Progressive determination, Totipotency and Nuclear transfer experiment.
(b) Induction of the primitive nervous system (Spemann's primary organizer).
(c) Nature & regionally specific properties of inductor.
(d) Competence.
(e) Abnormal (heterogeneous) inductors.
(f) Chemistry & mechanism of action inducing substances.
2. Cell differentiation and differential activity

UNIT III

1. Organogenesis:
(a) Morphogenetic processes in epithelia and mesenchyme in organ formation.
(b) Morphogenesis- of the brain; neural crest cells and their derivatives.
(c) Development of the eye, heart & alimentary canal and its accessory organs.

UNIT IV

1. Maternal contribution in early embryonic development
2. Genetic regulation of early embryonic development (Drosophila development as a model).
3. Embryonic adaptations:
(a) Evolution of the cleidoic egg and its structural and physiological adaptations.
(b) Development & physiology of the extra- embryonic membranes in amniotes. .
(c) Evolution of viviparity.
(d) Development, types and physiology of the mammalian placenta.

UNIT V

1. Metamorphosis in Amphibia
(a) Structural & Physiological changes during metamorphosis.
(b) Endocrine control of metamorphosis.
2. Regeneration:
(a) Types of regeneration, physiological, reparative and compensatory hypertrophy regenerative ability in chordates. .
(b) Morphological and histological process in amphibian limb regeneration.
(c) Wolffian regeneration
(d) Origin of cells of regeneration, de-differentiation, re-differentiation, pattern formation during amphibian limb regeneration, reasons for the absence of limb regenerative ability in mammals. Methods for induction of regenerations.

Suggested reading material :

- P.S. Verma & V.K. Agarwal Publisher: S. Chand Publishing
- Principles of Developmental Biology Author: S.K. Verma Publisher S. Chand Publishing
- Developmental Biology Author: Balinsky & Mohan P. Arora (Indian adaptation) Publisher: Tata McGraw Hill Education
- Cell and Developmental Biology Author: P.K. Gupta Publisher: Rastogi Publications
- Developmental Biology Author: Dr. S.S. Lal Publisher: Dominant Publishers & Distributors
- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology Author: P.S. Verma & V.K. Agarwal Publisher: S. Chand Publishing (Contains a major section on developmental biology)
- Developmental Biology: A Textbook for B.Sc. and M.Sc. Students Author: B.N. Pandey Publisher: S. Chand Publishing
- Developmental Biology and Embryology Author: N. Arumugam Publisher: Saras Publications

ZOO6.5DCCT403

PAPER XIII : ANIMAL ECOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line

- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Concepts of modern ecology.
2. Limiting factors: Liebig's law of minimum, Shelford's law of tolerance; combined concept of limiting factors, conditions of existence as regulatory factors.

UNIT II

1. Analysis of Environment . .
(a) The general environment.
(b) Role of Physical factors: temperature, light water; atmospheric gases, the media, substratum, climatology.
(c) Brief review of important physical factors as limiting factor.
(d) Nutrients and environment.

UNIT III

1. Organization at the population level:
(a) General properties of population.
(b) Population growth form and forces shaping the population growth.
(c) Measurement of Population. Simple numerical problems on measurement of population to be done.
(d) Animal aggregation and social life.
2. Organization at the community level:
(a) Biotic community concept.
(b) Community structure and concept of community dominance.
(c) Ecotone and concept of "edge effect".
(d) Pattern in communities: Stratification, zonation, activity, food web, reproductive and social structure.
(e) Community versus the continum.
(f) Evolution of Communities; Palaecology; Community structures in past ages.

UNIT IV

1. Ecological regulations:
(a) Succession in community: Basic types of succession, convergence and divergence in succession; modifications in succession; concept of climax, mono-climax versus poly-climax theory; barriers and ecesis in succession; Biome.
(b). Fluctuations within Community; irruptive cycle, fluctuation, causes of fluctuation cycles.
2. Environment and animals:

a. Nature and constituents of ecosystem.
b. Fundamental, operation of ecosystem
c. Flow of matter and energy in ecosystem
d. Homeostasis in the ecosystem
e. Cycling of chemical elements in ecosystem.
f. Concept of productivity: Productivity of land and water, measurement of productivity.

UNIT V

1. Organization and dynamics of ecological communities : The habitat approach: A detailed knowledge of extent, Zonation, environmental biota, adaptations and communities of fresh water, marine, terrestrial and estuarine ecosystems.
2. The ecological outlook: Space ecology, nuclear radiation, Climate change, Environmental challenges

Suggested reading material :

- P.S. Verma and V.K.Agarwal: Principles of Ecology, S.Chand Pulbicaltion
- E.G.P. Odum: Fundamnetals of Ecology
- S.V.S. Rana: Essential of Ecology and Environmental Science, Phi New Delhi
- K.C. Agrawal: Environmental Biology, Nidhi Publisher
- R.S. Rana: A textbook of Environmental Ecology, Khanna Publication, New Delhi
- S.V. Kumar: Modern concept of Ecology, Vikas Publications
- Taylor and Miller: Environmental Science,Cengage Learning Publication
- Ditta: Ecology and Environment, Pearlson Pulbication

PRACTICAL WORK BASED ON ZOO6.5DCCT402 & ZOO6.5DCCT403

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks : 20 Min. Marks 8

1. Development Biology:
(a) Study of development of frog or toad through:
(i) Formalin preserved or living material (egg, spawn, embryo, larvae and metamorphic stages).
(ii) Permanent microscopic slide of sections through representative regions of successive embryonic and larval stages
(b) Study of development of chick through
(i) Permanent whole mounts of successive embryonic stages and
(ii) Permanent microscopic slides of sections through representative regions of successive embryonic stages (Special emphasis should be laid on organogenesis and morphogenesis)
(c) Removal of chick embryos 18, 21, 24, 33, 72 and 92 hours from the egg and their study and identification in the living state.
(d) Study of (i) formalin preserved foetuses with placenta and (ii) histology of placenta of any mammal.

2. Ecology:
(a) Measurement of climatic factors (atmospheric, water, temperature and relative humidity)
(b) Measurement of water, soil pH, edaphic factors of soil, preparation of soil extract, determination of humidity in microhabitat. pH, Alkalinity of water; pH, dissolve oxygen, free

carbondioxide, chloride, salinity, temporary and permanent hardness of water, velocity of current.
(c) Measurement of population density, Numerical problems of population determination to be done
(d) A field study of any one of the following habitat to be assigned to an individual or to a group of students.
(e) Mode of life and types of beak and feet in birds.

ZOO6.5DCCT404A

PAPER XIV(A 1): CELL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

l. **Cell and tissue culture:**
(a) Behaviour of cells in culture
(b) Primary and established cell lines; kinetics of cell growth
(c) Natural and defined media for culture
(d) Importance of cell and tissue culture
2. Primary tissue explantation technique, organ culture
3. Basic concept of cloning; methods and utility.

UNIT II

1. **Chemical basis of "fixation" and "staining" and a discussion on the following techniques:**
(a) Freeze substitution
(b) Freeze drying
(c) Fresh and fixed frozen sections
(d) PAS, Metachromasia, Feulgen, lipid and protein staining techniques
(e) Intra-vital and supra-vital staining

UNIT III

1. **Techniques :**
   (a) Centrifugation and ultra-centrifugation
   (b) Single two dimensional & column chromatography
   (c) Paper, gel and disc electrophoresis

2. **Role and mechanism of action of the following enzymes at the cellular level**:
(a) ATPase
(b) Succinic dehydrogenase
(c) Acid and alkaline phosphatases
(d) Hyaluronidase

UNIT IV

Elementary concept of the principle & theory of microscopy as exemplified by the following:
(a) Phase contrast microscopy (b) Interference microscopy
(c) Polarizing microscopy

UNIT V

Elementary concept of the principle & theory of microscopy as exemplified by the following:
(a) Fluorescence microscopy (b Electron microscopy
(c) Ultra violet microscopy

ZOO6.5DCCT405A

PAPER XIV(A 2): CELL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Immune Response: Different types of immunity, Cellular aspects of Innate and

Adaptive Immunity : T and B Cells Structure and Function. Antigens, Antigenecityand molecules involved in innate and adaptive immunity, antigens, antigenecity and immunogenicity. MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors.

UNIT II

Humoral and cell-mediated immune responses. Primary and secondary immune modulation, the complement system, Toll-like receptors.
Structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions.

UNIT III

Inflammation, hypersensitivity and autoimmunity. Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines

UNIT IV

1. A general account of the effect of ionizing radiation at the cellular level
2. Elementary ideas of the origin of following diseases:
   (a) Glycogen storage disease (b) AIDS

UNIT V

1. Cellular aspects of the process of ageing
2. Molecular Maps of Animal Genomes: Molecular markers; Mapping population and Computer softwares, Genetic maps, cytogenetic maps, physical maps, integrated genomic maps, linkage disequilibrium (LD), Maps of the future, Sequencing of Genomes.

Suggested reading material:

- P.S.Verma : Cell Biology, Genetics, Molecular Biology. S.Chand
- PK Gupta : Cell and Molecular Biology, Rastogi Publications
- Nisha Tiwari, Sanjay Kumar Panda: Cell and Molecular Biology. Thakur Publication Private Limited
- E D P De Roberties, E M F De Roberties: Cell and Molecular Biology, B.I. Waverly Pvt. Ltd.
- Garald carp :Cell biology, Willey
- Bruce Alberts: Molecular biology of the all , WW Norton and Corporation
- Geoffrey M Cooper: The cell : a molecular approach, Sinauer Associates Inc.
- S.Kannan: Cell and Molecular Biology, MJP Publishers
- Harvey Lodish: Molecular cell biology
- Philip Sheeler:Cell and Molecular Biology, Wiley, W.H.Freeman & Co. Ltd

CELL BIOLOGY

PRACTICAL WORK BASED ON ZOO6.5DCCT404A & ZOO6.5DCCT405A

Max marks 80 Min. Marks 28

Internal Assessment Max. Marks:20 Min. Marks: 8

1. Study of germ cells; smear preparation of spermatozoa from vas deferens (vital staining) and permanent preparation of a single ovum

2. Histo-cytochemisty:
   (a) Methyl green-pyronin -method (b) Feulgen staining
   (c) Periodic acid schiff method (d) Alcian blue/ Bromophenol blue method
3. Histo,cytochemical staining of Enzymes in animal tissue:
   Staining of alkaline and acid phosphates, total proteins, Glucose 6 Phosphatase
4. Isolation of DNA from Onion tissue extract
5. Meiotic chromosome from Grasshopper/Cockroach testis/Onion flower bud by Squash Method
6. Spotting :
   Different stages of Meiotic Division
   Mammalian Histological slides
7. Field visit to Centers of research for knowledge of different instruments, artificial insemination etc. and preparing field report

ZOO6.5DCCT404B

PAPER XIV(B 1): ENVIRONMENTAL BIOLOGY

Max marks 80 Min. Marks 28

Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1.History of man and his cultural evolution in relation to impact on environment.

2. Management of Environment: Natural resources, their conservation and development:

Agriculture and forestry including pest management.

UNIT II

1. Wild life resources.
2. Mineral resources.
3. Aquaculture (Fresh, Marine and Prawn Culture)

UNIT III

1. Energy resources (Renewable and Non renewable energy), solar and wind.
2. River basin

UNIT IV

1. Pollution: (Monitoring, sources, effect and control)
   (a) Water (b)Air (c)Land (d)Thermal (e)Noise (f)Radiation
2. Bioremediation developing innovative solution for cleaning up pollution using micro-organisms.
3. Municipal water supply, sewage and its treatments

UNIT V

Environmental health
(a) Urban health problem. Impact of urbanization stress, Health status and health problem.
(b) Rural health problem
(c) Occupational health

ZOO6.5DCCT405B
PAPER XIV(B2): ENVIRONMENTAL BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C

- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Environmental legislation in Indian perspective
(i) Wildlife Protection Act 1972
(ii) Environmental Protection Act 1986
(iii) Biological Diversity Act 2002

UNIT II

Environmental legislation in Indian perspective
(i) International Conventions and Treaties
(ii) The national green tribunal act 2010
(iii)The waste management rule 2016

UNIT III

1. Environmental toxicology: Natural and man made toxicants in the environment and their impact on animal life in different ecosystems; Safety measures; Disposal and management of different types of wastes
2. Current Environmental Issues: Green House Effect, Ozone layer depletion, Desertification, Soil erosion, Population explosion, Sustainable development

UNIT IV

1. Applied Human Ecology
2. Methodology for environmental analysis:
   (a) Monitoring (b) Analysis or physical and chemical factors
   (c) Statistical analysis (d) Bioassay techniques
3. Environmental Impact Assessment

UNIT V

1. Remote sensing as a tool for study and management of ecosystem
2. Disaster Management : Thunderstorm, lightning, Floods, Cyclone, Land slides, Avalanche, Earthquakes

Suggested reading material :

- P.S. Verma and V.K.Agarwal: Principles of Ecology, S.Chand Pulbicaltion
- E.G.P. Odum: Fundamnetals of Ecology
- S.V.S. Rana: Essential of Ecology and Environmental Science, Phi New Delhi
- K.C. Agrawal: Environmental Biology, Nidhi Publisher
- R.S. Rana: A textbook of Environmental Ecology, Khanna Publication, New Delhi
- S.V. Kumar: Modern concept of Ecology, Vikas Publications
- Taylor and Miller: Environmental Science,Cengage Learning Publication
- Ditta: Ecology and Environment, Pearlson Pulbication

PRACTICALS FOR ENVIRONMENTAL BIOLOGY ZOO6.5DCCT404B & ZOO6.5DCCT405B

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

1. Air quality monitoring for:
   (a) Settelable matter (b) Suspended particulate matter
2. Soil/ Sediment analysis
   (a) EC (b) pH (c) Alkalinity
   (d) Organic matter (e) Texture (f) Salinity
3. Microscopie examination of water: Indicators of pollution, Zooplanktons and benthic fauna. Slide Preparation.

4. Statistical analysis: Plotting scatter diagram and regression line; Computing correlation coefficient and testing its significance for grouped and ungrouped data.

5.Spots
   (i). Micro and Macro Aquatic Flora and Fauna
   (ii). Instruments/Equipment in environmental studies: viz., pH meter, Turbidimeter, Conductivity meter, Spectrophotometer, Flame photometer, Centrifuge, BOD incubator, COD Flux unit, Air, water and mud samplers, Min.-Max. thermometer, Dry-Wet bulb thermometer, Barometer, Wind wane, Rain gauge, GPS, etc.

6. Field trip to any of the following habitats:
   (a) Forest: Wild life sanctuary (b) Fresh water habitat
   (c) Marine habitat (d) Semi arid habitat

(Students are expected to give complete ecological report of the trip including ecosystem structures; indicators and estimation of environmental degradation, if any)

Note: Use of animal for dissection and practical work is subject to the conditions that these are not banned under the Wildlife Protection Act and UGC guidelines

ZOO6.5DCCT404C
PAPER XIV(C 1): ENTOMOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)

- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

Definition of pest; Types of pest; General idea of damage caused by pests;

UNIT II

Principal methods of pest control: Physical, Mechanical, Cultural, Use of Botanicals, Biological and Legal;

UNIT III

The concept of IPM; A general idea of plant protection organization in India
Development of resistance to chemicals

UNIT IV

Ecology: effect of physical factors. Intra specific and inter-specific relations; dynamics of population

UNIT V

Chemical control: Insecticides: their chief types, modes of action and methods of application/ formulation; a general idea of appliances used in the application of insecticides and their safe handling.

ZOO6.5DCCT405C
PAPER XIV (C 2): ENTOMOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks

- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

A general knowledge of chemosterilants, attractants, repellants, pheromones, growth regulators and other compounds

Life history, damage caused and control of stored grain pests of cereals and pulses (including general idea of storage)

UNIT II

Life history, damage caused and control of 3 major pests of the main crops: wheat, paddy, maize, jowar, millet, sugarcane, cotton and oil seeds

UNIT III

Social life in Isoptera and Hymenoptera, caste determination in social insects;

Life cycle of aphids, Phase theory of locust

UNIT IV

Beneficial insects: Silkworm, honey bee and lac insect and industries related to them; Insects as vectors of diseases and their control– mosquitoes, house flies, sand flies, lice, fleas.

UNIT V

Insect borne diseases of man – Typhus, yellow fever, dengue fever, malaria, encephalitis, plague, leishmaniasis ; Forensic Entomology : Subfields, Scope and Applications. Importance of Insects in medico-legal investigations

Suggested reading material :

- Text book of entomology. a d AIMS. Springer CBS publisher
- General and applied entomology: KC Choudhary. Ahsan publishing house
- Principal of insect morphology: RE Snodgrass. Cornell University Press
- Introduction to insect: Borror Triplehorn & Johnson Saunders. college publishing
- Modern entomology : D B Tembhare. Himalaya publishing house
- Applied entomology: PD Srivastava. Kalyani publishers Delhi
- Insect Ecology and integrated paste Management : Dhaliwal and Arora .Kalyani publisher
- Handbook of practical Entomology : Meera Srivastava. Surya Prakashan Mandir Bikaner
- Agriculture insect paste and their control: V B Awasthi .scientific publisher Jodhpur
- Entomology Ecology and behaviour: PJ Gullan and Cranston. Wiley blackwell publisher
- Biological control of insect paste : TV Sathe .Daya publishing house
- Aadhunik keet Vigyan: B L Jat. Rita Publication Agra
- A manual of practical Entomology: volume first and second Ghosh & Sen. Emkay Publication

- Fundamentals of applied Entomology : RT Cotton. macmillan Publisher

ENTOMOLOGY PRACTICAL BASED ON ZOO6.5DCCT404C & ZOO6.5DCCT405C

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

1.Dissections of grasshopper, locust, house cricket, bug, honey bee, wasp, beetle to study important features of the digestive, circulatory, respiratory, excretory, nervous, reproductive and neuroendocrine systems.
2. Familiarity with techniques and appliances of applying insecticides, experiments for testing the insecticides.
3. Knowledge of rearing insects and of maintaining the insectary.
4. Exercise in ecology: Soil pH, water pH, free carbon dioxide; dissolved oxygen, chlorides, total alkalinity and total salinity.
5. Drosophila culture in Laboratory: Collection, Handling and Identification of Male and Female Drosophila
6. A tour to visit important centers of entomological studies.
(Note : Use of animal for dissection and practical work is subject to the conditions that these are not banned under the Wildlife Protection Act and UGC guidelines.)

ZOO6.5DCCT404D
PAPER XIV (D 1): FISH BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)
- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. A general survey of world fisheries, survey of principal fisheries of India (Fresh water, estuarine and marine).
2. Plankton in relation to fisheries.

UNIT II

1. The biology of Indian major carps, catfishes, Hilsa, sardine, mackerel, sharks, prawns and oysters.
2. Pisciculture and its importance, with special reference to India.

UNIT III

1. A brief outline on the methods of fishing in fresh water of India. Crafts & Gears used in fishing.

2. Biochemical composition of fish; fish as food.

UNIT IV

1. Bi-products of fishing industry, with special reference to India.

2. Ecological factors affecting the life of fishes; marine ecosystems.

3. Fish and mankind.

UNIT V

1 . Age and growth determination in fishes

2. Population dynamics: Estimation of population number and mortality rates in fresh waters

3. Fecundity: eggs and life history of fish production with special reference to fresh water

ZOO6.5DCCT405D
PAPER XIV(D 2): FISH BIOLOGY

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

- **NOTE:** Scheme of Examination for M.Sc. (Semester IV)

- Section A (Marks 2x10 = 20)
- Answer all 10 questions question no (i) to (v) objective (vi) to (x) filing the blanks or one line
- Section B (Marks 6x5 = 30)
- Answer all five questions. Each question has internal choice (Answer limit 200 words). Each question carry 6 marks
- Section C
- Answer any three questions out of five question (Answer limit 500 words). Each question carry 10 marks

UNIT I

1. Aquaria and their uses, setting up and maintenance of aquaria
2. Exotic fishes and their role in Indian fresh waters

UNIT II

1. Diseases of fishes (symptoms, etiology and treatment)

i. Bacterial Disease
ii. Viral Disease
iii. Fungal Disease
iv. Protozoan Disease
v. Crustacean Disease

2. Problems of fresh water pollution in relation to fisheries with special reference to Rajasthan

UNIT III

1.Adaptations in Fishes: Deep Sea and Hill Streams

2.Courtship and parental care, a general study of fish behavior

UNIT IV

1.Sound producing organs

2.Bioluminescence

UNIT V

1.Electric Organs

2.Poisons and Venoms: Poison Glands in Fishes

3.Migration and its causes

Suggested reading material :

- A text book of Fish Biology and Fisheries : S.S.Khanna & H.R.Singh, Narendra Publishing House
- Hand book of Fish and Fisheries : R.K.Sinha, Agrotech Press
- Biology of Fishes : Richard Moore & Quentin Bone, Taylor & Franscis Ltd.
- Biology and Ecology of Fishes, Diana John Wiley
- Fish and Fisheries of India : Pandey and Shukla, Rastogi Publications

FISH BIOLOGY PRACTICAL BASED ON ZOO6.5DCCT404D & ZOO6.5DCCT405D

Max marks 80 Min. Marks 28
Internal Assessment Max. Marks:20 Min. Marks: 8

1. Micro-technical procedures: Preparation and study of serial sections of a larval fish and representative tissues and organs of fish.
2. Collection of local fishes and their identification upto the species level; Study of the available museum specimens of Teleostomi. Identification of fingerlings of Indian Major Carps.
3. Hydro-biological Studies:
(a) Analysis of water to determine the pH, free carbon dioxide; dissolved oxygen, chlorides, calcium, total alkalinity and total salinity.
(b) Collection: estimation and analysis of plankton.
4. Induced spawning
5. Field studies
(a) Visit at an important marine Biological or fisheries centre in the country. The suggested places for this work are Veraval, Central Institute of Fisheries Education at Bombay and National Institute of Oceanographic Research at Goa.

Note: A record of the work done under 5 Items has to be compulsorily submitted by each candidate.

(Note: Use of animals for dissection/practical work is subject to the conditions that these are not banned under the wild life protection act and UGC guidelines.

SEMESTER IV
(Duration 4 h)

SCHEME OF PRACTICAL EXAMINATION AND DISTRIBUTION OF MARKS

Day 1 (ZOO6.5DCCT406)

Ecology and Developmental Biology

(a) Exercise in Ecology	12 Marks
(b) Exercise in developmental biology	10 Marks
(c) Permanent preparation	08 Marks
(d) spots (5)	20 Marks
(e) Tour Report and Seminar	10 Marks
(f) Viva- voce	10 Marks
(g) Class Record	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

Day 2 (ZOO6.5DCCT407 A/B/C/D)

Board Second (Special paper)

(A) Cell Biology

(a) Microtomy (Double Staining)	14 Marks
(b) Biochemical Estimation	10 Marks
(c) Karyotype/Slide Preparation/ Techniques	10 Marks
(d) Spots (4)	16 Marks
(e) Project /Field report (Hand written, not more than 100 pages	10 Marks
(f) Viva- voce	10 Marks
(g) Class Record	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

(B)Environmental Biology

(a) Air/Soil analysis	14 Marks
(b Microscopic Examination of water and slide preparation(Zooplankton/ Benthos)	10 Marks
(c) Statistical method	10 Marks
(d Spotting (4)	16 Marks
(e) Field trip/ Project report	10 marks
(f) Viva- voce	10 Marks
(g) Class Record	10 marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

(C) Entomology

(a) Dissection/ Demonstration	20 Marks

(b) Exercise in Ecology	14 Marks
(c) Spot	16 Marks
(d) Project/ Field Report	10 Marks
(e) Viva- voce	10 Marks
(f) Class Record/	10 Marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**

(D) Fish Biology

(a) Species identification using taxonomic key (2 fishes)	12 Marks
(b) Hydro-biological Exercise	12 Marks
(c) Induced Spawning/Permanent Preparation	10 Marks
(d) Project/Field report(Hand written, not more than 100 pages)	10 Marks
(e) Identification and comments on Spots (4)	16 Marks
(f) Viva-voce	10 Marks
(g) Class Record	10 marks
Total	**80 Marks**
Internal Assessment	**20 marks**
Grand Total	**100 Marks**