

SYLLABUS FOR B.Sc. COURSE IN ZOOLOGY

UG SEMESTER

SESSION – 2019-20 onwards



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

B. Sc. I Semester			
Core Course Code		Paper Title	Credits
ZOO-CC- 111	Theory	Animal Diversity	04
ZOO-CC- 112	Practical	Animal Diversity	02
AEC – 100		Ability Enhancement Compulsory course (AEC) : English Communication	02
Total Credits			06 + 02

Core Course: Zoology I
ANIMAL DIVERSITY
ZOO-CC-111
(Credits: 04)
THEORY

12hrs/unit (Total : 60 hrs)

UNIT – I

- **Kingdom Protista:**

General characters and classification up to classes.
Locomotory Organelles and locomotion in Protozoa.

- **Porifera:**

General characters and classification up to classes.
Canal System in *Sycon*

- **Cnidaria:**

General characters and classification up to classes.
Polymorphism in Hydrozoa.

- **Platyhelminthes:**

General characters and classification up to classes.
Life history of *Taenia solium*

UNIT - II

- **Nemathelminthes:**

General characters and classification up to classes.
Life history of *Ascaris lumbricoides* and its parasitic adaptations.

- **Annelida:**

General characters and classification up to classes.
Metamerism in Annelida

- **Arthropoda:**

General characters and classification up to classes.
Vision in Arthropoda
Metamorphosis in Insects

UNIT - III

- **Mollusca:**

General characters and classification up to classes.
Torsion in Gastropods

- **Echinodermata:**
General characters and classification up to classes
Water-vascular system in Asteroidea
- **Protochordates:**
General features and Phylogeny of Protochordata

UNIT - IV

- **Agnatha:**
General features of Agnatha and classification of cyclostomes up to classes
- **Pisces:**
General features and Classification up to orders.
Osmoregulation
- **Amphibia:**
General features and Classification up to orders
Parental care

UNIT - V

- **Reptiles:**
General features and Classification up to orders
Poisonous and nonpoisonous snakes,
Biting mechanism in snakes
- **Aves:**
General features and Classification up to orders.
Flight adaptations
- **. Mammals:**
Classification up to orders.
Origin of mammals

Note: Classification of Unit 1-10 to be followed from “Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition

SUGGESTED READINGS

1. Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson00
4. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
5. Pough H. *Vertebrate life*, VIII Edition, Pearson International.
6. Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

Core Course: Zoology I
ANIMAL DIVERSITY
ZOO-CC-112
(Credits: 02)
Practical

1. **Kingdom Protista:** *Amoeba*, *Euglena*, *Plasmodium*, *Paramecium*
2. **Porifera:** *Sycon* (including T.S. and L.S.), *Hyalonema*, and *Euplectella*
3. **Cnidaria:** *Obelia*, *Physalia*, *Aurelia*, *Tubipora*, *Metridium*
4. **Platyhelminthes:** *Taenia solium* and Study of its life history stages
5. **Nemathelminthes:** Male and female *Ascaris lumbricoides*
6. **Annelida:** *Aphrodite*, *Nereis*, *Pheretima*, *Hirudinaria*
7. **Arthropoda:** *Palaemon*, *Cancer*, *Limulus*, *Palamnaeus*, *Scolopendra*, *Julus*,
Periplaneta, *Apis*
8. **Mollusca:** *Chiton*, *Dentalium*, *Pila*, *Unio*, *Loligo*, *Sepia*, *Octopus*
9. **Echinodermata:** *Pentaceros*, *Ophiura*, *Echinus*, *Cucumaria* and *Antedon*
10. **Protochordata:** *Balanoglossus*, *Herdmania*, *Branchiostoma*
11. **Agnatha:** *Petromyzon*
12. **Pisces:** *Sphyrna*, *Pristis*, *Torpedo*, *Labeo*, *Exocoetus*, *Anguilla*
13. **Amphibia:** *Ichthyophis/Ureotyphlus*, *Salamandra*, *Bufo*, *Hyla*
14. **Reptilia:** *Chelone*, *Hemidactylus*, *Chamaeleon*, *Draco*, *Vipera*, *Naja*, *Crocodylus*, *Gavialis*
Key for Identification of poisonous and non-poisonous snakes
15. **Aves:** Study of six common birds from different orders
16. **Mammalia:** *Sorex*, Bat, *Funambulus*, *Loris*

An “**animal album**” containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose. These need not be repeated as drawings by the album maker.

B. Sc. II Semester			
Core Course Code		Paper Title	Credits
ZOO-CC- 211	Theory	Comparative Anatomy and Developmental Biology of Vertebrates	04
ZOO-CC- 212	Practical	Comparative Anatomy and Developmental Biology of Vertebrates	02
211-FC- ENV		Ability Enhancement Compulsory Course (AEC): Environmental Studies	02
Total Credits			06 + 02

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

ZOO-CC- 211

(Credits: 04)

THEORY

12hrs/unit (Total : 60 hrs)

A. COMPARATIVE ANATOMY

UNIT - I

- **Integumentary System:** Derivatives of integument w.r.t. glands and digital tips
- **Skeletal System:** Evolution of visceral arches
- **Digestive System:** Brief account of alimentary canal and digestive glands

UNIT - II

- **Respiratory System:** Gills, lungs, air sacs and swim bladder
- **Circulatory System:** Evolution of heart and aortic arches

UNIT - III

- **Urinogenital System:** Succession of kidney, Evolution of urinogenital ducts
- **Nervous System:** Comparative account of brain
Sense Organs: Types of receptors

UNIT - IV

B. DEVELOPMENTAL BIOLOGY

- **Early embryonic development**

Gametogenesis: Spermatogenesis and oogenesis wrt mammals.

vitellogenesis in birds

Fertilization: external (amphibians), internal (mammals), blocks to polyspermy

Early development of frog and humans (structure of mature egg and its membranes patterns of cleavage, fate map, upto formation of gastrula)

Types of morphogenetic movements

Fate of germ layers

Neurulation in frog embryo

UNIT – V

- **Late embryonic development**

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology

Metamorphic events in frog life cycle and its hormonal regulation.

- **Control of Development**

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

SUGGESTED READINGS

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills
- Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
- Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.
- Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc.

Core Course: Zoology II
COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF
VERTEBRATES
ZOO-CC- 212
(Credits: 02)
PRACTICAL

A. OSTEOLOGY:

Disarticulated skeleton of fowl

- Vertebrae (atlas, fused thoracic, synsacrum, pygostyle)
- Limb bones (humerous, radioulna, femur, tarsometatarsus)
- Girdles (pectoral and pelvic)

Disarticulated skeleton of rabbit

- Vertebrae (atlas, axis, lumbar, sacrum, caudal)
- Limb bones (humerous, radioulna, femur, tibiofibula)
- Girdles (pectoral and pelvic)

Skull

- One herbivorous (Rabbit)
- One carnivorous (Dog)

DEVELOPMENTALBIOLOGY

Frog - Study of developmental stages - whole mounts and sections through permanent slides.

- Cell stage (2,4,8,16)
- Late cleavage
- Embryo – (4mm, 7mm)
- Egg (WM)
- Morula, Blastula, Gastrula, Neurala
- Tadpole gill (T.S.)
- External Gill (WM)
- Tadpole (WM)
- Tail region (C.S)
- Study of different types of placentae- histological section through permanent slides or photomicrographs.
- Study of placental development in humans by ultrasound scans.
- Examination of gametes – frog/rat- sperm and ova through permanent slides or photomicrographs.

B. Sc III Semester			
Core Course Code		Paper Title	Credits
ZOO-CC- 311	Theory	Physiology and Biochemistry	04
ZOO-CC- 312	Practical	Physiology and Biochemistry	02
ZOO-SEC-I -313	Skill Enhancement Course	Pisciculture	02
Total Credits			06 + 02

SEC Course (any four, one in each semester from III Sem. To VI Sem.)

- (1) Public health and hygiene
- (2) Aquarium fish keeping
- (3) Pisciculture
- (4) Poultry farming
- (5) Sericulture
- (6) Apiculture

CORE COURSE : ZOOLOGY III
PHYSIOLOGY AND BIOCHEMISTRY
ZOO-CC- 311
(Credits: 04)
THEORY

12hrs/unit (Total : 60 hrs)

UNIT- I

Digestion and Respiration

- Digestion in different segments of the alimentary canal
- Absorption of carbohydrates, proteins & lipids
- Pulmonary ventilation, Respiratory volumes and capacities
- Transport of Oxygen and carbon dioxide in blood

UNIT- II

Cardiovascular system and Excretion

- Blood: Composition, Hemostasis
- Heart structure, Origin and conduction of the cardiac impulse
- Cardiac cycle
- Structure of nephron
- Mechanism of Urine formation

UNIT- III

Nerve, muscle, Reproduction and Endocrine Glands

- Structure of a neuron, Resting membrane potential and Graded potential
- Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres,
- Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction
- Physiology of male reproduction: hormonal control of spermatogenesis
- Physiology of female reproduction: hormonal control of menstrual cycle
- Structure and function of pituitary, thyroid, parathyroid, pancreas and adrenal glands

UNIT- IV

Carbohydrate Metabolism and Lipid Metabolism

- Chemical Structures of Carbohydrate, Lipids
- Structure of monosaccharide, disaccharide and poly saccharide
- Structure of fats; saturated and un saturated fatty acids.
- Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain
- Biosynthesis and β oxidation of palmitic acid

UNIT- V

Protein metabolism and Enzymes

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- Chemical Structures of Proteins
- Structure of amino acids and peptides;
- Essential and non – essential amino acids Transamination, Deamination and Urea Cycle
- Introduction, Mechanism of action,
- Kinetics, Inhibition and Regulation.

SUGGESTED READINGS

- Tortora, G.J.& Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn., John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th edn., McGraw Hill
- Guyton, A.C. & Hall, J.E. (2011) Textbook of Medical Physiology, 12th edn., Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009) . Principles of Biochemistry.IV Edition. W.H Freeman and Co.
- Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

CORE COURSE : ZOOLOGY III
PHYSIOLOGY AND BIOCHEMISTRY
ZOO- CC- 312
(Credits: 02)
PRACTICAL

A. PHYSIOLOGY

1. Preparation of hemin and hemochromogen crystals
2. Examination of permanent histological sections of mammalian pituitary, thyroid, parathyroid, pancreas, adrenal, glands, testis, ovaries.
3. Examination of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage small intestine, large intestine.

B. BIO-CHEMISTRY

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
2. Colour reactions to identify functional group in the given solution of proteins
3. Study of activity of salivary amylase under optimum conditions

SKILL ENHANCEMENT COURSES (ZOO-SEC-I-313)
PISCICULTURE
(Credits: 02)

06 hrs/unit (Total : 30 hrs)

Unit 1: Scope of Aquaculture. Importance of cultivable fresh water, marine ornamental species.

Unit 2: Fish farm Maintenance – Farm management technique, Measurements of water quality parameter, accessories used in Farm management viz Aerator, Filter, paddler

Unit 3: Fish culture technique, Monoculture, Polyculture and monosex culture, Induced fish breeding, Integrated fish farming

Unit 4: Fish nutrition and fish formulations live fish transport.
Fisheries economics and extension

Unit 5: Prevention and control of fish diseases.
Prevention and processing of fish.
Fisheries management and conservation.

B. Sc. IV Semester			
Core Course Code		Paper Title	Credits
ZOO-CC- 411	Theory	Genetics and Evolutionary Biology	04
ZOO-CC- 412	Practical	Genetics and Evolutionary Biology	02
ZOO-SEC-II - 413		Skill Enhancement Course (SEC): Poultry Farming	02
Total Credits			06 + 02

CORE COURSE: ZOOLOGY IV
GENETICS AND EVOLUTIONARY BIOLOGY
ZOO-CC- 411
(Credits: 04)
THEORY

12hrs/unit (Total : 60 hrs)

Unit I

Introduction to Genetics and Mendelian Genetics and its Extension

- Mendel's work on transmission of traits,
- Principles of Inheritance, Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and codominance
Structure and function of genes, molecular basis of genetic variation.
- Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression
- Sex linked inheritance, extrachromosomal inheritance involving mitochondria and chloroplast.

Unit II

Linkage, Crossing Over, Chromosomal Mapping and Sex Determination

- Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over
- Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.
- Chromosomal mechanisms, dosage compensation

Unit III

Mutations and Quantitative Genetics

- Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation,
- Aneuploidy and Polyploidy
- Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations
- Molecular basis of Mutations
- Quantitative and multifactor inheritance
- Transgressive variations, Heterosis
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Unit IV

History of Life, Introduction to Evolutionary Theories, Direct Evidences of Evolution

- Major Events in History of Life
- Lamarckism, Darwinism, Neo-Darwinism
- Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Unit V

Processes of Evolutionary Change, Species Concept, Evolution above species level, Extinction

- Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism)
- Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection
- Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)
- Macro-evolutionary Principles (example: Darwin's Finches)
- Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
- Minkoff, E. (1983). *Evolutionary Biology*. Addison-Wesley.

CORE COURSE: ZOOLOGY IV
GENETICS AND EVOLUTIONARY BIOLOGY
ZOO-CC- 412
(Credits: 02)
PRACTICAL

A. GENETICS

- Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
- Study of Linkage, recombination, gene mapping using the data.
- Study of Human Karyotypes (normal and abnormal).

B. EVOLUTIONARY BIOLOGY

- Study of fossil evidences from plaster cast models and pictures
- Study of homology and analogy from suitable specimens/ pictures
- Charts:
 - a. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
 - b. Darwin's Finches with diagrams/ cut outs of beaks of different species

SKILL ENHANCEMENT COURSES (ZOO-SEC-II-413)
POULTRY FARMING
(Credits: 02)

06hrs/unit (Total : 30 hrs)

- Unit 1:** External morphology of variety of Fowls such as Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.
- Unit 2:** Classification of Fowls based on their use : Meat type such as Broilers, Egg type such as White Leghorn and Commercial layers, Dual purpose varieties, Game and Ornamental purpose varieties.
- Unit 3:** Feeding Poultry – Management of Egg Layers – Management of Broilers in large scale farms.
- Unit 4:** Poultry diseases Viral, Bacterial, Fungal, Protozoan and Parasitic Lice etc., Prevention and precautions during vaccination.
- Unit 5:** Management of a modern Poultry Farms – Progressive plans to promote Poultry as a Self-Employment venture.

B. Sc. V Semester			
Core Course Code		Paper Title	Credits
ZOO-SEC-III -513	(Theory)	Skill Enhancement Course (SEC): Sericulture	02
ZOO-DSE -514	(Theory)	Discipline Specific Elective (DSE - I) Immunology	04
ZOO-DSE -515	(Practical)	Discipline Specific Elective (DSE - I) Immunology	02
Total Credits 06 + 02			

SKILL ENHANCEMENT COURSES (ZOO-SEC-III-513)
SERICULTURE
(Credits: 02)

06hrs/unit (Total : 30 hrs)

- Unit 1:** Classification of commercial varieties of mulberry silk worms, Mulberry plantation establishment and cultivation practices.
- Unit 2:** Diseases of mulberry silk worms – fungal, bacterial, viral and Nematode diseases, Deficiency diseases and their remedial measures.
- Unit 3:** Silkworm rearing operations – Chawki rearing and Late age rearing techniques.
- Unit 4:** Physical and commercial characters of Cocoons. Reeling operations, Importance of by-products of Sericulture.
- Unit 5:** Economics of Sericulture – Future and progress of Sericulture Industry in India. Prospects of Sericulture as Self-Employment venture.

DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY(ZOO-DSE-514)
IMMUNOLOGY
(Credits: 04)
THEORY

12hrs/unit (Total : 60 hrs)

UNIT-I

- Overview of the immune system- Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system
- Cells and organs of the immune system- Haematopoiesis, cells of immune system and organs (primary and secondary lymphoid organs) of the immune system

UNIT-II

- Antigens- Basic properties of antigens, B and T cell epitopes, haptens and adjuvants
- Antibodies- Structure, classes and function of antibodies, monoclonal antibodies, antigen-antibody interactions as tools for research and diagnosis

UNIT-III

- Working of the immune system I- Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing
- Working of immune system II- Basic properties and functions of cytokines, types and functions of complement system

UNIT-IV

- Immune system in health and disease I- Hypersensitivity: types and functions, introduction to concepts of autoimmunity and immunodeficiency

UNIT-V

- Immune system in health and disease II- Infectious agents and how they cause diseases, course of adaptive response to infection, general introduction to vaccines

SUGGESTED READINGS

- Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
- Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's
- Essential Immunology, Blackwell Publishing.

DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY (ZOO-DSE-515)
IMMUNOLOGY
(Credits: 02)
PRACTICAL

1. Study of lymphoid organs (by slides or micrographs) : Spleen, Lymph nodes, Peyer's patches, thymus
bone marrow Bursa fabricus
2. ABO blood group determination
3. Demonstration of Ouchterlony's double diffusion assay
4. Preparation, cell count and percentage viability of spleenocytes
5. Demonstration of Enzyme linked immunosorbent assay (DOT-ELISA)
6. Demonstration of immunoelectrophoresis

B. Sc. VI Semester			
Core Course Code		Paper Title	Credits
ZOO-SEC-IV -613	(Theory)	Skill Enhancement Course (SEC): Apiculture	02
ZOO-DSE - 614	(Theory)	Discipline Specific Elective (DSE - II) - Applied Zoology	04
ZOO-DSE- 615	(Practical)	Discipline Specific Elective (DSE-II) – Applied Zoology	02
Total Credits 06 + 02			

SKILL ENHANCEMENT COURSES (ZOO-SEC-IV-613)
APICULTURE
(Credits: 02)

06 hrs/unit (Total : 30 hrs)

- Unit 1:** History – Biology and classification of species of honey bees; Social organization of honey bee colony.
- Unit 2:** Bee hive – Flora for apiculture – Selection of bees for apiculture, Method of bee Keeping; Indigenous method of Extraction of honey
- Unit 3:** Modern method of apiculture – Appliances for modern method. Diseases of Honey bee and control measures.
- Unit 4:** Products of bee keeping : Honey – Bee wax and Bee Yeman – Honey : Production, Chemical composition – Economic importance of Honey bee wax.
- Unit 5:** Bee enemies, Bee keeping industry; Recent efforts – Modern method in employing honey bees for cross pollination in horticultural gardens.

DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY(ZOO-DSE-614)
APPLIED ZOOLOGY
(Credits: 04)
THEORY

12hrs/unit (Total : 60 hrs)

UNIT-I

Introduction to Host-parasite Relationship, Epidemiology of Diseases, Rickettsiae and Spirochaetes

- Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis
- Transmission, Prevention and control of diseases: Tuberculosis, swine flu, typhoid
- Brief account of *Rickettsia prowazekii*, *Borrelia recurrentis* and *Treponema pallidum*

UNIT-II

Parasitic Protozoa and Parasitic Helminthes

- Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*
- Life history and pathogenicity of *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*

UNIT-III

Insects of Economic Importance and Insects of Medical Importance

- Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*; Safe storage of stored grains
- Life cycle, medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*, distinguishing features of *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*, *Phlebotomus argentipes*

UNIT-IV

Animal Husbandry and Poultry Farming

- Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle
- Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

UNIT-V

Fish Technology

- Genetic improvements in aquaculture industry;
Induced breeding and transportation of fish seeds

SUGGESTED READINGS

- Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
- Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
- Kumar and Corton. *Pathological Basis of Diseases*.
- Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
- Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).
- Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
- Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
- Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY (ZOO-DSE-615)
APPLIED ZOOLOGY
(Credits: 02)
PRACTICAL

1. Study of permanent slides/photomicrographs and specimens of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*
2. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
3. Study of insect damage to different plant parts
 - a. **Leaf roller** : *Sylepta derogate* (Lady finger)
Sphenoptera perotetti
 - b. **Stem borer** : *Scipophaga incertulas*
Chilo infuscatellus.
 - c. **Root borer** : *Emmalocera depraessella*.
Leucinodes orbonalis.
4. Identifying feature and economic importance of *Helicoverpa* (*Heliothis*) *armigera*, *Achaea janata*, *Papilio demoleus*, *Pyrilla perpusilla*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum* *Trogoderma granarium*, *Rhizopertha dominica*.
5. Visit to poultry farm or animal breeding centre. Submission of visit report.
6. Maintenance of freshwater aquarium.

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG I SEMESTER

SESSION – 2019-20 onwards



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M.Sc. I Semester

Paper Course Code	Paper Title	Credits
P-I ZOO-CC-121	Principles of Systematic Zoology – Theory	04
ZOO-CC-122	Principles of Systematic Zoology – Practical	01
P-II ZOO-CC-123	Biostatistics and Computational Biology – Theory	04
ZOO-CC-124	Biostatistics and Computational Biology – Practical	01
P-III ZOO-CC-125	Endocrinology – Theory	04
ZOO-CC-126	Endocrinology – Practical	01
P-IV ZOO-CC-127	Animal Physiology – Theory	04
ZOO-CC-128	Animal Physiology – Practical	01
Total Credits		20

PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY

Course Code ZOO CC 121

PRINCIPLES OF SYSTEMATIC ZOOLOGY

LTPC 400 4

12hrs/unit (Total : 60 hrs)

Unit I

Principles of Systematics

- Definition and basic concepts of biosystematics
- Alfa, beta, Gamma Taxonomy
- Newer trends in Taxonomy (Molecular, Cytological taxonomy with details)
- Theories of Systematics

Unit II

Species Concept

- Species categories
- Typological, Nominalistic, Biological, Evolutionary, Phylogenetic & Recognition species concept
- Polytypic species
- Intraspecific categories
- Hierarchy of categories

Unit III

Taxonomic collections

- Systematic collections: value and scope of collection
- Curation of collections, housing, cataloging
- Loans and expendable collection materials
- Taxonomic characters, different types:-(Morphological, behavioural, cytological and biochemical) and process of identification

Unit IV

Procedure of classifications

- Qualitative and quantitative analysis of Variations and procedure of classifying
- Non genetic and Genetic Variations
- Individual, social, ecological and traumatic Variation
- Sex associated and non-sex associated variations

Unit V

Principles and application of Zoological nomenclature

- Taxonomic publications
- Rules of Zoological Nomenclature
- Interpretation of Rules of nomenclature
- Type specimens and their importance

Suggested Reading Material (All latest editions)

1. M.Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise, Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson, Biodiversity, Academic Press, Washington.
4. G.G. Simpson, Principle of Animal taxonomy, Oxford IBH Publishing Company.
5. E. Mayer, Principles of Systematic Zoology. McGraw-Hill Book Co.
6. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northem & Co.

M.Sc. COURSE, SESSION – 2019-20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 122

PRINCIPLES OF SYSTEMATIC ZOOLOGY

Practical

L T P C

0 0 2 1

1. Recent classification of animals exemplified by museum specimens.
2. Identification of animal species with the help of taxonomic keys.
 1. Insect fauna up to order
 2. Fish fauna up to families
 3. Identification of earthworm
3. Methods of taxonomic collection and preservations.
4. Collection of local fauna.
5. Morphological variations in animal phyla.
6. Methods of measuring biodiversity.
7. Methods of key preparation
8. Mitochondrial gene diversity, COX gene diversity.

M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 123
BIostatistics AND COMPUTATIONAL BIOLOGY

Theory

L T P C

4 0 0 4

12hrs/unit (Total : 60 hrs)

Unit I

- Matrices and Vectors
- Exponential functions
- Periodic functions and differential equations
- Mathematical modeling

Unit II

- Sampling, Data collection and recording.
- Central tendency – concept; arithmetic mean, mode, median for ungrouped and grouped data.
- Measures of dispersion: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability.

Unit III

- Skewness, Kurtosis
- Probability - normal, poisson and binomial
- parametric and non - parametric test.

Unit IV

- Statistical Methods: Hypothesis testing, significance and correlation. Correlation.
- Linear models and regressions. Pearson and other correlation coefficients. Multiple regressions.
- Distribution- Normal, t-test and chi square test
- Analysis of variance

Unit V

- Basic concepts of computer, hardware and operating systems: Windows, Android, iOS
- Use of common application software in biology: word processing, spreadsheets, graphics and data base.
- Introduction to web browsing software and search engines with special reference to online resources.
- Definition, history, scope and applications of bioinformatics, Biological Databases primary & Secondary Databases e.g. GenBank, EMBL, DDBJ, Entrez, OMIM, SWISS-Prot etc. Use of PubMed, BLAST etc.

Suggested Reading Material

1. Batschelet, E., Introduction to mathematics for life scientists. Springer-Verlag, Berlin.
2. Jorgensen, S.E., Fundamentals of ecological modeling, Elsevier, New York.
3. Swartzman, G.L., and S.P.O. Kaluzny, Ecological simulation primer, Mac millan, New York.
4. Lendren, D., Modelling in behavioral ecology, Chapman & Hal, London, U.K.
5. Sokal, R.R. and F.J. Rohlf, Biometry, Freeman, San Francisco.
6. Snedecor, G.W. and W.G. Cochran, Statistical methods, Affiliated East-West Press, New Delhi (Indian ed.).
7. Green, R.H., Sampling design and statistical methods for environmental biologists, John Wiley & Sons, New York.
8. Murray, J.D., Mathematical biology, Springer-Verlag, Berlin.
9. Pielou, E.C., The interpretation of ecological data: A primer on classification and ordination.

M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 124
BIOSTATISTICS AND COMPUTATIONAL BIOLOGY
PRACTICAL
L T P C
0 0 2 1

LIST OF PRACTICALS

1. Numerical Based on:
2. Matrices.
3. Mean, median and mode.
4. Mean deviation, variance, standard deviation and standard error.
5. Representation of data: Bar diagrams, π -diagrams, Histograms, Frequency polygons and ogives.
6. t-test
7. F-test
8. Chi square test
9. ANOVA
10. Demonstration of PubMed in searching scientific literature using authors name, fields, limits etc.
11. Demonstration of BLAST in comparing Protein Sequences.
12. Use of Sigma Stat/Prism Software for Statistical analysis.
13. Use of Search engines and online resources.

M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 125
ENDOCRINOLOGY

Theory

L T P C

4	0	0	4
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12hrs/unit (Total : 60 hrs)

Unit-I

General Endocrinology, Reproductive hormones and behavior

- Introduction to endocrinology and endocrine system
- Phylogeny and ontogeny of endocrine glands
- Discovery and Classification of hormones
- Overview of reproductive hormones secretion in males and females
- Regulatory mechanism of reproductive hormones in spermatogenesis and oogenesis
- Hormones effects on behavior and immunity
- Biological activities of prostaglandins

Unit II

Biosynthesis of Hormones and Regulation

- Biosynthesis of steroid hormones de novo
- Biosynthesis and amino-acid derived small size hormones
- Biosynthesis and simple peptide hormones – Pre – and Pro- hormones
- Hormones and Homeostasis
- Termination mechanism of hormone action.

Unit-III

Pituitary and Pineal glands

- Pituitary gland: histological structure and function
- Hormones secretion from pituitary gland and mechanism of action
- Autoimmune disorder of pituitary gland
- Pineal gland: histological structure and function
- Hormones secretion from pineal gland and mechanism of action
- Role of pineal gland in stress related diseases

Unit-IV

Thyroid, Parathyroid and Thymus glands

- Thyroid gland: histological structure and function
- Hormones secretion from thyroid gland and mechanism of action
- Imbalance of thyroid hormone and related diseases

- Parathyroid gland: histological structure and function
- Hormones secretion from parathyroid gland and mechanism of action
- Parathyroid gland disease (hyperparathyroidism)
- Structure and function of Thymus

Unit-V

Adrenal gland and hormones of GIT

- Physiology of adrenal gland: structure and function of excretory hormones
- Mechanism of action of adrenal gland secreted hormones
- Endocrine diseases involve dysfunctions of the adrenal gland
- Hormonal control of digestion – from esophagus to intestine (feeding to absorption)
- Hormonal regulation of carbohydrate, protein and lipid metabolism

Suggested Reading

1. E.J.W. Barrington, General and Comparative Endocrinology, Oxford, Clarendon Press.
2. P.J. Bentley, Comparative Vertebrate Endocrinology, Cambridge University Press.
3. R.H. Williams, Text Book of Endocrinology, W.B. Saunders.
4. C.R. Martin, Endocrine Physiology, Oxford University Press.
5. A. Gorbman et. al. Comparative Endocrinology, John Wiley & Sons.
6. W.S. Hoar General and comparative Animal Physiology.
7. Harpers Biochemistry by David A. Bender et al.

M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 126
ENDOCRINOLOGY

Practical

L T P C

0	0	2	1
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1. Histological study of different endocrine glands (Pituitary, Thyroid, Parathyroid, Adrenal, Thymus, Gonads and Pancreas).
2. Microtomy to prepare stained, permanent mounts of different endocrine glands
3. Study of estrous cycle of rat
4. Sperm count and mobility assay
5. Eosin-Nigrosin staining of live and dead spermatozoa
6. To detect the presence of human chorionic gonadotropin hormone
7. Preparation of melanophore index of rasbora fish scale due to the effect of adrenalin hormone.

M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 126
ENDOCRINOLOGY
L T P C
0 0 2 1

List of Practical :

1. Enzymatic activity of human salivary amylase.
- 2 Effect of pH & temperature on amylase activity.
- 3 Effect of substrate concentration on rate of reaction.
- 4 Demonstration of oxygen consumption of a laboratory animal.
- 5 Demonstration of respiratory rate by estimation of dissolved oxygen (DO).
- 6 Study of capillary circulation in the web of frog.
- 7 Measurement of blood pressure by Sphygmomanometer.
- 8 Counting of blood cells in an insect / vertebrate by haemocytometer.
- 9 Determination of bleeding time.
- 10 Demonstration of role of Malphigian tubules in insect excretion.
- 11 Test of Ammonia, urea, uric acid and creatinine in urine sample.
- 12 Study of color change mechanism in fish & frog.
- 13 Study of osmotic hemolysis and chemical hemolysis.

M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 127
ANIMAL PHYSIOLOGY

L T P C
4 0 0 4

12hrs/unit (Total : 60 hrs)

Unit-I

Food, Feeding and Digestion

- Types of food and nutrition: proteins, carbohydrates, fats, vitamins and minerals
- Feeding Mechanisms in general
- Physiology of digestion: structure and function of digestive system
- Role of visceral and glandular organs in digestion
- Absorption and food assimilation

Unit-II

Respiration and Circulation

- Types of respiration and respiratory systems in animals
- Physiology of Respiration: structure and function of respiratory organs
- Mechanism of O₂ & CO₂ transport in blood
- Overview of lymphatic system
- Blood: hemopoiesis, composition, coagulation mechanism, blood pressure
- Blood groups, Rh factor, and blood related diseases

Unit-III

Nervous and Muscular System

- Nerves & Nervous system: types, structure and function
- Synapse: neurotransmitters, mechanism of excitation
- Muscles: types, structure & function
- Muscle biomechanics: contraction and relaxation mechanism

Unit-IV

Excretion and Reproduction

- Physiology of excretion: structure and function of excretory organs
- Types of excretory products in animals
- Mechanism of urea production
- Physiology of reproduction: structure and function of male and female reproductive system
- Fertilization and post-fertilization developments

Unit-V

Physiological Regulations and Ocular Physiology

- Thermoregulation: mechanism and regulation
- Osmoregulation: mechanism and regulation
- Overview of sensory system: eye, ear, mouth, nose & skin
- Ocular Physiology: structure, function and components of eye
- Mechanism of vision development and related diseases

Suggested Readings:

1. W.S. Hoar General and comparative Animal Physiology.
2. Schiemdt-Nielsen Animal Physiology: Adaptation and Environment. Cambridge
3. C.L. Prosser Comparative Animal Physiology W.B. Saunders & Company
4. R. Eckert Animal physiology: Mechanism and Adaptation W.H.Freeman& Company.
5. C.R. Martin, Endocrine Physiology, Oxford University Press.
6. Harpers Biochemistry by David A. Bender et al.

LIST OF PRACTICALS
M.Sc. COURSE, SESSION – 2019–20
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 128
ANIMAL PHYSIOLOGY (PRACTICAL)
L T P C
0 0 4 1

List of practical:

1. Histological study of all organs systems
2. Enzymatic activity of human salivary amylase
3. Effect of pH & temperature on amylase activity
4. Measurement of blood pressure.
5. Determination of Blood groups and Rh Factor
6. Counting of blood cells by haemocytometer
7. Determination of bleeding time
8. Test of Ammonia, urea, uric acid and creatinine in urine sample
9. Study of osmotic haemolysis and chemical haemolysis

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG II SEMESTER

SESSION – 2019-20



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M.Sc. II Semester

Paper Course Code	Paper Title	Credits
P-I ZOO-CC-221	Population Genetics and Evolution – Theory	04
ZOO-CC-222	Population Genetics and Evolution – Practical	01
P-II ZOO- CC -223	Gamete Biology – Theory	04
ZOO- CC -224	Gamete Biology – Practical	01
P-III ZOO- CC -225	Tools and Techniques for Biology – Theory	04
ZOO- CC -226	Tools and Techniques for Biology – Practical	01
P-IV ZOO- CC -227	Biochemistry – Theory	04
ZOO- CC -228	Biochemistry – Practical	01
P-V ZOO-E-229A	Elective Course – Theory	03
ZOO-E-229B	Elective Course – Practical	01
	Total Credits	24
ZOO- OE- 229	OPEN ELECTIVE	02

Elective Courses for M.Sc. II Semester

1. Medical Biochemistry
2. Genetic Engineering
3. Environmental Health

Elective Course for M.Sc. II Semester
 ZOO-E-129A (Theory) and ZOO-E-129B (Practical)

Cancer Biology & Therapeutics
 Vermibiotechnology
 Neurobiology
 Biological Methods to Study the Tissue

P.G. COURSE, SESSION 2019-20
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 221
POPULATION GENETICS AND EVOLUTION

Theory

L T P C

4 0 0 4

12hrs/unit (Total : 60 hrs)

Unit-I

- 1.0 Concepts of evolution and theories of organic evolution with an emphasis on Darwinism
- 2.0 Neo-Darwinism .
- 2.1 Hardy-Weinberg law of genetic equilibrium
- 2.2 A detailed account of destabilizing forces:
 - (i) Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration
 - (v) Meiotic drive
- 3.0 Quantifying genetic variability
- 3.1 Genetic structure of natural populations
- 3.2 Phenotypic variation
- 3.3 Models explaining changes in genetic, structure of populations
- 3.4 Factors affecting human disease frequency

Unit-II

- 4.0 Molecular population genetics
- 4.1 Patterns of change in nucleotide and amino acid sequences
- 4.2 Ecological significance of molecular variations
- 4.3 Emergence of Non-Darwinism-Neutral Hypothesis
- 5.0 Genetics of quantitative traits in populations
- 5.1 Analysis of quantitative traits
- 5.2 Quantitative traits and natural selection
- 5.3 Estimation of heritability
- 5.4 Genotype-environment interactions
- 5.5 Inbreeding depression and heterosis
- 5.6 Molecular analysis of quantitative traits
- 5.7 Phenotypic plasticity

Unit-III

- 6.0 Genetics of speciation
- 6.1 Phylogenetic and biological concept of species
- 6.2 Patterns and mechanisms of reproductive isolation
- 6.3 Models of speciation (Allopatric, sympatric, parapatric)
- 7.0 Molecular Evolution
- 7.1 Gene Evolution
- 7.2 Evolution of gene families, Molecular drive
- 7.3 Assessment of molecular variation

Unit-IV

- 8.0 Origin of higher categories
- 8.1 Phylogenetic gradualism and punctuated equilibrium
- 8.2 Major trends in the origin of higher categories
- 8.3 Micro-and Macro-evolution
- 9.0 Molecular phylogenetics
- 9.1 How to construct phylogenetic trees?
- 9.2 Phylogenetic inference-Distance methods, parsimony methods, maximum likelihood method
- 9.3 Immunological techniques
- 9.4 Amino acid sequences and phylogeny
- 9.5 Nucleic acid phylogeny-DNA-DNA hybridizations, Restriction Enzyme sites, Nucleotide sequence comparisons and homologies
- 9.6 Molecular clocks

Unit-V

- 10.0 Origin and evolution of economically important microbes and animals
- 11.0 Population genetics and ecology
- 11.1 Metapopulations
- 11.2 Monitoring natural populations
- 11.3 Why small populations become extinct?
- 11.4 Loss of genetic variations
- 11.5 Conservation of genetic resources in diverse taxa

Suggested- Reading Material

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia Univieristy Press.
2. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
3. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland.
4. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
5. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
6. King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge.
7. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
8. Smith, J.M. Evolutinary Gentic. Oxford University Press, New York.
9. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston London.

P.G. COURSE, SESSION 2019-20
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 222
POPULATION GENETICS AND EVOLUTION

Practical

L T P C

0 0 2 1

List of Practical

1. Distribution of gene frequency in a particular population (Brahmins, Saxenas etc.) with reference to:
 - a. Size of index and ring finger.
 - b. Freeness ear lobes.
 - c. Blood groups, A,B, AB, O, Rh, MNS etc.
2. Phenotypic plasticity in
 - a. Butterfly
 - b. Rasbora
 - c. Ophiocephalus or Notopterus
3. Electrophoretic pattern of DNA fragments belonging to Horse, Man, Monkey, Cow etc after treatment with particular restriction endonuclease.
4. Distribution of frequency of serum isozymes like, LDH & DH, Glutamate dehydrogenase, glucose-6-phosphate dehydrogenase etc in a population.
 1. Some numerical problems on Hardy Weinberg's law.
 2. Determination of average Heterozygosity and gene polymorphism

P.G. COURSE, SESSION 2019-20
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 223
GAMETE BIOLOGY

Theory

L T P C

4 0 0 4

12hrs/unit (Total : 60 hrs)

Unit-I 1.0 Heterogamy in eukaryotes

2.0 Comparative account of differentiation of gonads in a mammal and an invertebrate

3.0 Leydig cells

3.1 Morphology

3.2 Differentiation

3.3 Function and its regulation

4.0 Spermatogenesis

4.1 Morphological basis in Rodents

4.2 Morphological basis in any Invertebrate

4.3 Gamete specific gene-expression and genomics

5.0 Biochemistry of Semen

5.1 Semen composition and formation

5.2 Assessment of sperm functions

5.3 Y-specific probes

Unit-II 6.0 Fertilization

6.1 Pre-fertilization events

6.2 Biochemistry of fertilization

6.3 Post-fertilization events

7.0 Collection and cryopreservation of gametes and embryos

8.0 Ovarian follicular growth and differentiation

8.1 Morphology

8.2 Endocrinology

8.3 Molecular Biology

8.4 Oogenesis and vitellogenesis

8.5 Ovulation and ovum transport in mammals

Unit-III 9.0 Biology of sex-determination and sex-differentiation a comparative account

10.0 Multiple ovulation and embryo transfer technology (MOET)

10.1 *In vitro* oocyte maturation

10.2 Superovulation

10.3 In vitro fertilization

11.0 Transgenic animals and knock-outs

11.1 Production

11.2 Applications

11.3 Embryonic stem cells

Unit-IV 12.0 Care and breeding of experimental animals including bioethics

14.0 Assisted reproduction technologies

14.1 Embryo sexing and cloning

14.2 Screening for genetic disorders

14.3 ICSI, GIFT etc.

14.4 Cloning of animals by nuclear transfer

Unit-V 15.0 Teratological effects of Xenobiotics.

15.0 Immunocontraception

15.1 Gamete specific antigens

15.2 Antibody mediated fertilization block and termination of gestation

15.3 Other contraceptive technologies

15.1 Surgical methods

15.2 Hormonal methods

15.3 Physical barriers

15.4 IUCD

Suggested Reading Material

1. Austen, C.R and Short, RV. Reproduction in animals.
2. Schatten and Schatten. Molecular biology of fertilization.
3. F.T. Longo. Fertilization, Chapman & Hall.
4. R.G. Edwards. Human Reproduction.

P.G. COURSE, SESSION 2016-17
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 224
GAMETE BIOLOGY

Practical

L T P C

0 0 2 1

List of Practical

1. Demonstration of different types of Ovarioles in insects. e.g. in (i) Cockroach/Grasshopper (Panoistic type) (ii) *Dysdercus/Bagrada/Sphaerodema* (Acrotrophic type) and (iii) *Musca/Drosophila* (polytrophic type).
2. Squash preparation of testes of male insects to demonstrate spermatogenesis.
3. Section of ovaries of mammals showing oogenesis, development of graafian follicles and corpus luteum.
4. Section of testes of a mammal (rat/rabbit) showing spermatogenesis.
5. Effect of xenobiotics on teratogenesis using snail egg masses as model material.
6. Development of chick showing morphogenesis & organogenesis by using 2,4,6,8,10 days incubated hen's eggs.

P.G. COURSE, SESSION 2019-20
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 225
TOOLS AND TECHNIQUES FOR BIOLOGY

Theory

L T P C

4 0 0 4

60 hours

Unit-I 1.0 Assay

1.1 Definition and methods for assay

1.2 Chemical assays

1.3 Biological assays-in vivo and in vitro assays

2.0 Principles and uses of analytical instruments - balance, pH meter, spectrophotometer, centrifuge

Unit-II 3.0 Microscopy - Principle of light, phase-contrast, fluorescence, confocal, electron microscopes

4.0 Microbiological techniques

4.1 Media preparation and sterilization

4.2 Inoculation and growth monitoring

4.3 Use of fermentors

4.4 Microbial assays

5.0 Cell culture techniques

5.1 Design and functioning of tissue culture laboratory

5.2 Culture media preparation and cell harvesting methods

5.3 Cell proliferation measurements

5.4 Cell viability testing

Unit-III 6.0 Cryotechniques

6.1 Cryopreservation for cells, tissue, organisms

6.2 Cryotechniques for microscopy

6.3 Freeze-drying for physiologically active substances

7.0 Separation techniques in biology

7.1 Molecular separations by chromatography and electrophoresis

7.2 Organelle separation by centrifugation etc.

7.3 Cell separation by flow cytometry, density gradient centrifugation

Unit-IV 8.0 Computer aided techniques for data presentation, data analyses, statistical techniques, special software for specific tasks

9.0 Radioisotope and mass isotope techniques in biology

9.1 Sample preparation for radioactive counting

9.2 Autoradiography

9.3 Metabolic labeling

9.4 Magnetic Resonance Imaging

Unit-V 10 Immunological techniques based on antigen-antibody interactions

9

11 Surgical techniques

11.1 Organ ablations (eg: ovariectomy, adrenalectomy etc.)

11.2 Perfusion techniques
11.3 Indwelling catheters
11.4 Stereotaxy
11.5 Parabiosis
12 Biosensors

Suggested Reading Material (All latest Editions)

1. Animal Cell Culture - A practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Editions
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.H. Goulding, ELBS Edn.

P.G. COURSE, SESSION 2019-20
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 226
TOOLS AND TECHNIQUES FOR BIOLOGY

Practical

L T P C

0 0 2 1

List of Practical

1. Procedure of microtomy for animal tissue
2. Demonstration of microscopy: phase-contrast, fluorescence, confocal and electron
3. Isolation of Protein from plant/animal tissues
4. Demonstration of protein precipitation
5. Estimation of proteins by spectrophotometer
6. Separation of proteins by SDS-PAGE
7. Isolation of nucleic acids from plant/animal tissues
8. Estimation of nucleic acids by spectrophotometer
9. Separation of nucleic acids by agarose gel electrophoresis
10. Demonstration of PCR and RT-PCR
11. Demonstration of cell viability assays

P.G. COURSE, SESSION 2019-20
M.Sc. II SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 227

Biochemistry

Theory

L T P C

4 0 0 4

60 hours

Unit I : Amino acids and proteins

1. Amino acids
2. Acids and bases
3. Protein structure
4. Myoglobin and hemoglobin
5. Collagen
6. Protein purification
7. Electrophoresis of proteins
8. Protein sequencing and peptide synthesis
9. Amino acid metabolism

Unit II : Enzymes

1. Introduction to enzymes
2. Thermodynamics
3. Enzyme kinetics
4. Enzyme inhibition
5. Regulation of enzyme activity

Unit III : Nucleic Acids

1. DNA structure
2. DNA replication in prokaryotes & eukaryotes
3. RNA structure
4. Transcription in prokaryotes & eukaryotes
5. Regulation of transcription by RNA Pol II
6. Processing of eukaryotic pre-mRNA
7. Ribosomal RNA
8. Transfer RNA

Unit IV : Protein Synthesis

1. The genetic code
2. Translation in prokaryotes
3. Translation in eukaryotes
4. Protein targeting
5. Protein glycosylation

Unit V : Carbohydrate & Lipid metabolism

1. Monosaccharides, disaccharides, Polysaccharides and oligosaccharides
2. Glycolysis & Gluconeogenesis
3. Pentose phosphate pathway

4. Glycogen metabolism & its regulation
5. Structures and roles of fatty acids
6. Fatty acid breakdown & synthesis
7. Triacylglycerols
8. Cholesterol
9. Lipoproteins

Suggested readings:

1. B.D. Hames. Instant Notes in Biochemistry. Bios Pub. UK.
2. Voet D. and Voet J.G., Biochemistry, John Willey and Sons.
3. Nelson D.L., Cox M.M. Lehninger, Principles of Biochemistry, MacMilan , USA.
4. Metzler D.E. and Metzler C.M. , Biochemistry, Wiley – Liss.
5. Devlin T.M. , Text book of Biochemistry , Willey-Liss.

P.G. COURSE, SESSION 2019-20
M.Sc. II SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 228
Biochemistry
Practical
L T P C
0 0 2 1

Practical:

1. Preparation of standard graph of protein for quantitative estimation of protein
2. Preparation of standard graph of DNA for quantitative estimation of DNA
3. Preparation of standard graph of RNA for quantitative estimation of RNA
4. Preparation of standard graph of Pi for determining V-max of mitochondrial ATPase enzyme
5. Effect of substrate concentration, temperature and pH on mitochondrial ATPase enzyme
6. Chromatography ; TLC and Paper chromatography
7. DNA isolation
8. RNA isolation

Suggested readings:

1. Plummer D.T. , Practical Biochemistry , Tata McGraw-Hills.
2. Wilson K. and Walker K. , Principles & Techniques of Practical Biochemistry. Cambrigde Uni.Press.

M.Sc. COURSE, SESSION - 2019-20
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A

Environmental Health

L T P C

2 0 0 2

Unit I: Molecular toxicology

1.1 Basic understanding of environmental health impact

Unit II: Epigenetic traits and determinants

2.1 Basic understanding of tools and techniques used for pragmatic analysis of human exposome

Unit III: Impact assessment of technological advancements

3.1 Synthetic pesticides

3.2 radiation and nuclear technology

3.3 cell phones

3.4 genetically modified products.

Unit IV: Occupational medicine

4.1 Detection and control of environmentally transmitted microbial hazards

4.2 industrial hygiene

4.3 occupational safety management

Unit V: Environmental law, regulation and policy

5.1 Articulate the implications of human-environmental interactions for social decision making

5.2 environmental regulation and allocation of public health resources

6 hours/unit

M.Sc. COURSE, SESSION – 2019-20
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 229 B
L T P C
0 0 2 1

LIST OF PRACTICAL

1. Histone modifications and DNA methylation
2. Hands-on-experience to exposome analytics (HPLC, GC etc.) used for evaluating dose-response and exposure-response relationship
3. Basic toxicogenomic profiling through software-user interface

M.Sc. COURSE, SESSION - 2019-20
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A
Medical Biochemistry
L T P C
2 0 0 2

Unit-I 1.1 Biochemical basis of diseases/disorders, diagnosis and treatment

1.2 Molecular deficiency disorders

1.2.1 Enzyme deficiency: inborn errors of metabolism

1.2.1.1 Alkaptonuria

1.2.1.2 Phenylketonuria

1.2.1.3 Lesh-Nyhan syndrome

1.2.2 Protein defects/ deficiency

1.2.2.1 Cystic fibrosis

1.2.2.2 Sickel cell anaemia

1.2.2.3 Thalassemia

Unit-II Transport/storage associated disorders

2.1 Hypercholesterolemia and atherosclerosis

2.2 A-Beta-lipoproteinemia

2.3 Tay-Sachs disease

2.4 Gout

Unit-III Apoptosis and its implications in health and disease

3.1 Process of apoptosis

3.1.1 Induction and biochemical changes

3.1.2 Execution

3.1.3 Phagocytosis of apoptotic bodies

3.2 Regulation of apoptosis

3.3 Implications

3.3.1 Programmed cell death and development

3.3.2 Development of immunological tolerance

3.3.3 Neurological disorders

Unit-IV Cancer

4.1. Biochemical alterations during carcinogenesis

4.2. Regulatory mechanisms as targets for cancer therapy

Univ-V 5.1 Drug action, abuse and catabolism

5.1.1 Mechanisms

5.1.2 Drug addiction, alcohol toxicity

5.1.3 Catabolism of drugs

5.2. Recent trends in therapy

5.2.1 Biomolecules as diagnostic markers and therapeutic agents

5.2.2 Gene technology and gene therapy

5.2.3 Drug delivery and targeting

5.3. Medical gerontology

Books Recommended

1. Murray et al: Harper's Illustrated Biochemistry (27th ed 2006, McGraw Hill)
2. Ganong: Review of Medical Physiology (21st ed 2003, Lange Medical Publications)
3. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
4. Goldsby et al: Immunology (5th ed 2003, Freeman)
5. Bhagvan: Medical Biochemistry (4th ed 2004, Hap)
6. Goodman et al: The Pharmacological Basis of Therapeutics (7th ed 1991, Macmillan Publishers)
7. Smith & Marks: Basic Medical Biochemistry (2nd ed 2005, LWW Lippincott's)
8. Chatterjea & Shinde: Medical Biochemistry (6th ed 2005, Jaypee brothers)
9. Bennett & Brown: Clinical Pharmacology (9th ed 2005, Elsevier)
10. Saini & Kaur: Clinical Biochemistry (1st ed 2001, CBS Publ)

6 hours/unit

LIST OF PRACTICALS
M.Sc. COURSE, SESSION –2019-20
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Medical Biochemistry
Course Code ZOO E 229 B

1. Study of pathological condition in rat/mouse model: liver cirrhosis, diabetes and ascites tumor
2. Analysis of enzymatic/biochemical markers from serum/tissues of rat/mouse model
 - 2.1 Studies on the anti-oxidant enzymes (SOD, catalase and GPx) in normal and diseased rats
 - 2.2 Native-PAGE analysis of LDH isoforms
 - 2.3 Spectrophotometric assay of SGOT (AST) and SGPT (ALT)
 - 2.4 Estimation of bilirubin concentration
3. Study of apoptosis in liver cirrhotic/tumor model
 - 3.1 Analysis of DNA-degradation pattern using agarose gel electrophoresis
 - 3.2 Western blot analysis of release of cytochrome C from mitochondria
 - 3.3 Expression analysis of Bcl2, Bax and pro-apoptotic factors (Caspase3 and 9)
4. Demonstration of expression of a gene/protein during aging

M.Sc. COURSE, SESSION - 2019-20
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A

Genetic Engineering

Theory

L T P C

2 0 0 2

60 hours

Unit-I Principles and Tools of Genetic Engineering

- 1.1 Introduction of genetic engineering
- 1.2 Restriction enzymes and other enzymes for DNA manipulation
- 1.3 Vector types: cloning & expression
- 1.4 Probes

Unit-II Cloning strategies

- 2.1 cDNA & genomic libraries

Unit-III Screening of clones

- 3.1 Preparation of probes
- 3.2 Hybridization: Southern, Northern & Immunoscreening

Unit-IV Characterization of clones

- 4.1 DNA Sequencing
- 4.2 Microarray

Unit-V Application:

- 5.1 Transgenic organism and genetically modified organisms animal cloning
- 5.2 Site-directed mutagenesis
- 5.3 Generation of knock out animals
- 5.4 Gene therapy

Books Recommended

- 1. Brown: Gene Cloning & DNA analysis (2001, Blackwell)
- 2. Lewin: Genes IX (2008, Jones & Bartlett)
- 3. Lodish et al : Molecular cell biology (6th edition 2007, Freeman)
- 4. Asubel et al : Current protocol in molecular biology (1944, Wiley)
- 5. Sambrook & Russell : Molecular cloning (2001, Cold Spring Harbour)

M.Sc. COURSE, SESSION – 2014–15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 229 B
Genetic Engineering
Practical
L T P C
0 0 2 1

LIST OF PRACTICALS

1. Demonstration of DNA gel electrophoresis
2. Demonstration of northern, southern hybridization
3. Structure, function & working of instruments: PCR & DNA sequencer.
4. Preparation of models of nucleotides.

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG III SEMESTER

SESSION – 2016-17



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M. Sc. III Semester			
Core Course Code		Paper Title	Credits
ZOO C 321	Theory	Structure & Function of Invertebrates	04
ZOO C 322	Practical	Structure & Function of Invertebrates	01
ZOO C 323	Theory	Immunology	04
ZOO C 324	Practical	Immunology	01
ZOO C 325	Theory	Cell Architecture	04
ZOO C 326	Practical	Cell Architecture	01
ZOO C 327	Theory	Cell Physiology	04
ZOO C 328	Practical	Cell Physiology	01
ZOO C 325	Theory	Environmental Biology (Principles of Environmental Biology)	04
ZOO C 326	Practical	Environmental Biology (Principles of Environmental Biology)	01
ZOO C 327	Theory	Environmental Biology (Composition of Biosphere)	04
ZOO C 328	Practical	Environmental Biology (Composition of Biosphere)	01
ZOO C 325	Theory	Structure and Function of Insects	04
ZOO C 326	Practical	Structure and Function of Insects	01
ZOO C 327	Theory	Insect Taxonomy	04
ZOO C 328	Practical	Insect Taxonomy	01
ZOO C 325	Theory	Fish Structure and Function	04
ZOO C 326	Practical	Fish Structure and Function	01
ZOO C 327	Theory	Fish Anatomy & Physiology	04
ZOO C 328	Practical	Fish Anatomy & Physiology	01
ZOO E 329 A	Theory	Elective	02
ZOO E 329 B	Practical	Elective	01
Total Credits			23

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
General Paper – I
STRUCTURE & FUNCTION IN INVERTEBRATES
Course code ZOO C 321

L T P C

4 0 0 4

Theory

Unit – I

Principles of Animal taxonomy

- Special concept: International code of zoological nomenclature
- Taxonomic procedures: New trends in taxonomy
- Animal collection, handling and preservation

Organization of coelom

- Acoelomates
- Pseudocoelomates
- Coelomates: Protostomia and Deuterostomia

Unit – II

Locomotion

- Flagella and ciliary movement in Protozoa
- Hydrostatic movement in Coelenterate, Annelid and Echinoderm

Nutrition and digestion

- Patterns of feeding and digestion in lower metazoan
- Filter feeding in Polychaeta, Mollusca and Echinodermata

Unit – III

Respiration

- Organs of respiration: Gills, lungs and trachea
- Respiratory pigments
- Mechanism of respiration

Excretion

- Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules
- Mechanisms of excretion
- Excretion and osmoregulation

Unit – IV

Nervous System

- Primitive nervous system: Coelenterata and Echinodermata
- Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).
- Trends in neural evolution

Unit – V

Invertebrate Larvae

- Larval forms of free living invertebrates
- Larval forms of parasites
- Strategies and Evolutionary significance of larval forms

Minor Phyla

- Concept and significance
- Organization and general characters

9 hours/unit

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
General Paper – I, Practical
STRUCTURE & FUNCTION IN INVERTEBRATES
Course code ZOO C 322
 L T P C
 0 0 2 1

List of practical

1. Nervous System: Crab; Sepia/Loligo
 2. Mounting: Nephridia and Spermatheca in Earthworm
 3. Respiratory System: Mounting of Gills, Trachea and Book lungs
- PROTOZOA – Gregarines, Monocystis, Ceratium, Euplotes, Didinium, Noctiluca, Radiolaria, Stentor, Opalina
- PORIFERA – Sectional view of Sycon (T.S., L.S.), Grantia (T.S.)
- CNIDARIA – Slides of Obelia polyp and Medusa, Pennaria, Aurelia – Tentaculocysts
- Museum Specimens of Virgularia, Spongodus, Zoanthus, Favia
- HELMINTHES – Slides of Temnocephala
- Museum Specimens of ascaris lumbricoides, Taenia solium, Planaria
- ANNELIDA – Slide of Ozobranchus, Glossiphonia
- Museum Specimens of Eunice, Chloea flava, Polynoe, Terebella, Eurythoe
- ARTHROPODA – Slides of Cyclops, Daphnia, Chelifer, Section of Peripatus
- Museum Specimens of Balanus, Lepas, Palinurus, Uca, Pycna, Hippa, Gongylus, Belostoma, Limulus, Squilla, Eupagurus
- MOLLUSCA -
- Museum Specimens of Dolabella, Pteria, Nerita, Sanguinolaria, Chicoreus, Ficus, Lambis, tridacna Onchidium, Olvia, Murex, Turritella, Bulla, Cardium, Arca
- ECHINODERMATA –
- Museum Specimens of Linckia, Echinodiscus, Holothuria, Antedon
- MINOR PHYLA – Slides of Bugula, Plumatella, Cristatella, Pectinella
- Museum Specimens of phoronis, Dendrostoma
- SPECIMENS – Aurelia – Planula, Redia, Cercaria, Filiform of strongyloides, Trochophore, Nauplius, Zoea, Mysis, Phyllosoma, Trilobite larvae of limulus, Antlion, Veliger, Bipinnaria, Ophio and Echinopluteus, Auricularia, tornaria.

Suggested Reading Material

1. Hyman, L.H. The invertebrates Vol. I Protozoa through Ctenophora, McGraw Hill Co. New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York&London.
4. Hyman, L.H. The Invertebrates Vol. 2 McGraw Hill Co. New York.
5. Hyman, L.H. The Invertebrates Vol. 8 McGraw Hill Co. New York 7 London

6. Barnes, R.D. Invertebrate Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel – Hunter, W.D. A biology of higher invertibrates, the Macmilan Co. Ltd. London
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol 5 McGraw Hill Co. New York
3. Read C.P. Animal Parasitism. Prentice Hall Inc. New Jersey

M.Sc. COURSE, SESSION – 2016–17

M. Sc. III Semester

General Paper – II, Theory

IMMUNOLOGY

Course code ZOO C 323

L T P C

4 0 0 4

Unit - I: Components of the Immune System

1. Introduction to the Immune System
2. Cells, Tissues, and Organs of the Immune System
3. Antibodies
4. Complement
5. T Cell Receptors and MHC Molecules

Unit - II: Modes of Immune Response

1. Mechanisms of Innate Immunity
2. Mononuclear Phagocytes in Immune Defense
3. Antigen Presentation
4. Cell Cooperation in the Antibody Response
5. Cell-mediated Cytotoxicity
6. Regulation of the Immune Response
7. Immune Responses in Tissues
8. Hypersensitivity (Type I, II, III, IV)

Unit - III: Defense against Infectious Agents

1. Immunity to Viruses
2. Immunity to Bacteria and Fungi
3. Immunity to Protozoa and Worms
4. Primary Immunodeficiencies
5. AIDS, Secondary Immunodeficiency and Immunosuppression
6. Vaccination

Unit - IV: Immune Responses against Tissues

1. Immunological Tolerance
2. Autoimmunity and Autoimmune Disease
3. Transplantation and Rejection
4. Immunity to Cancers

Unit - V: Tools in molecular immunology

1. Antibody generation (mAb, pAb)
2. Evaluation of immune-response (ELISA, RIA, Western blot, Immuno-precipitation, immuno-fluorescence, flow cytometry)

3. Qualitative, quantitative and kinetic modes of expression: Real-time PCR, Microarray, LC-MS)
4. Large data acquisition and analysis: Functional genomics, Immune-seq, Systems biology

9 hours/unit

M.Sc. COURSE, SESSION – 2016–17

M. Sc. III Semester

General Paper - II, Practical

IMMUNOLOGY

Course code ZOO C 324

L T P C

0 0 2 1

List of Practical

1. Immune system and organs in a mammalian animal model
2. Cells of the immune system (collection, isolation, characterization)
3. ELISA
4. Radial immuno-diffusion
5. Immunological diagnosis (Blood group)
6. Immunocytochemistry (Light, Fluorescent, Confocal Microscopy)
7. Flow cytometry (acquisition and analysis of immune cells)

Suggested Reading Material

1. Kuby Immunology, International Edition (2013) by Judy Owen, Jenni Punt and Sharon Stranford.
2. Fundamentals of Immunology, VII Edition (2012) by William E. Paul.
3. Immunology , VIII Edition (2013) by David Male, Jonathan Brostoff , David Roth and Ivan Roitt.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) III
CELL ARCHITECTURE
Course code ZOO C 325

Theory

L T P C

4 0 0 4

Unit – I

Prokaryotic and eukaryotic cell organization
Various types of microscopy to study cell architecture
Sorting cells and their parts: flow cytometry, fractionation, centrifugation

Unit – II

Cytoskeleton: microtubules, microfilaments and related proteins
Microtubule polymerization, dynamic instability and treadmilling
Actin polymerization dynamics, cell crawling

Unit – III

Cell wall architecture: lipid and protein in cellular membrane, protein lipid interaction
Specialized regions of the plasma membrane: pancreatic acinus, plasma membrane of intestinal epithelial cell, microvilli
Cell junction: tight junction, gap junction

Unit – IV

Integrins, Collagen and non – collagen components
Nucleus
Interphase nucleus
Biogenesis of nucleus

Unit – V

Endoplasmic reticulum,
Golgi complex,
Mitochondria,
Lysosomes, Vacuoles, peroxisomes

12 hours/unit

Suggested Reading Material

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing Inc., New York.
3. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) IV
CELL PHYSIOLOGY
Course code ZOO C 327
Theory
L T P C
4 0 0 4

Unit – I

Transport across prokaryotic cells
Osmosis: movement of water and regulation of cell volume in animal cells
Internalization of macromolecules and particles: endocytosis, exocytosis, pinocytosis, phagocytosis

Unit – II

Concept of receptors, receptor ligand binding, endocrine, paracrine and autocrine signaling
Receptor mediated endocytosis
Extracellular receptors and their coupling to different signals transducing machinery: ion channels, active transport and ion pumps

Unit – III

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through Gprotein coupled receptors, signal transduction pathways
Second messengers and regulation of signaling pathways: phosphatidylinositol, inositol trisphosphate, DAG, cAMP, cGMP, prostaglandins
Receptor regulation

Unit – IV

Oxygen consumption of cells: aerobic oxidation
Glycolysis and fermentation: anaerobic oxidation
Cell oxidation with emission of light: luminescence
Bioenergetics and Oxidative phosphorylation

Unit – V

Action potential of cells and conduction of electrical impulse
Coupled reaction, Group transfer, Biological energy transducers
Development, propagation and transmission of action potential
Synapses and impulse transmission, Neurotransmitter receptors

12 hours/unit

Suggested Reading Material

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing Inc., New York.
3. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) PRACTICAL
Course code: ZOO C 326
L T P C
0 0 2 1

List of Practical

1. Visualization methods for cells and sub-cellular components: light microscopy, phase contrast microscopy, scanning and transmission microscopes, laser scanning confocal microscope and atomic force microscope
2. Demonstration of cell sorting by flow cytometry
3. Use of different types of centrifuge

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) PRACTICAL
Course code: ZOO C 328
L T P C
0 0 2 1

1. Staining of Golgi complex, mitochondria, peroxisomes etc
2. Experiment on osmosis
3. Study of hemolysis
4. Introduction to nucleic acid and protein sequence databases: data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
Environmental Biology (Principles of Environmental Biology) (SPECIAL PAPER) III
Course Code ZOO C 325

Theory

L T P C

4 0 0 4

Unit I

- Definition, principles and scope of Environmental Science.
- Earth, Man and Environment. Ecosystems, Pathways in Ecosystems.
- Physico-chemical and Biological factors in the Environment.

Unit II

- Geographical classification and zones.
- Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
- Natural resources, conservation and sustainable development.

Unit III

- **Chemical composition of Air** : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical smog.
- **Water Chemistry** : Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.
- **Soil Chemistry** : Inorganic and organic components of soil, Nitrogen pathways and NPK in soils.

Unit IV

- **Toxic Chemicals in the environment – Air, Water** : Pesticides in water.
- Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, Os and PAN Pesticides, Insecticides, MIC.
- Carcinogens in the air, water and soil.

Unit V

- **Principles of Analytical Methods** : Titrimetry, Gravimetry, Colourimetry, Spectrophotometry.
- Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC,

HPLC.

- Electrophoresis. X – ray fluorescence, X – ray diffraction, Flame photometry.

M.Sc. COURSE, SESSION – 2016–17

M. Sc. III Semester

Environmental Biology (Composition of Biosphere) (SPECIAL PAPER) IV

Course Code ZOO C 327

Theory

L T P C

4 0 0 4

Unit I

- Structure and functions, Abiotic and Biotic components, energy flows, Food chains, Food web, Ecological pyramids, types and diversity.
- Ecological Succession, Population, Community ecology and Parasitism, Prey – predator relationships.

Unit II

- Common flora and fauna in India
- Aquatic : Phytoplankton, Zooplankton and Macrophytes.
- Terrestrial : Forests
- Endangered and Threatened Species

Unit III

- Biodiversity and its conservation : Definition, ‘Hotspot’s of Biodiversity, Strategies for Biodiversity conservation. National Parks and Sanctuaries. Gene pool.
- Microflora of Atmosphere : Air Sampling techniques. Identification of aeroallergens. Air – borne diseases and allergies.
- Environmental Biotechnology : Fermentation Technology, Vermiculture technology, Biofertilizer technology.

Unit IV

- Sun as source of energy; solar radiation and its spectral characteristics.
- Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas.
- Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy Conversion, wind, geothermal energy; solar collectors, photovoltaics, solar ponds.
- Nuclear energy-fission and fusion; magnetohydrodynamic power.
- Bioenergy-energy from biomass and biogas, anaerobic digestion.
- Energy use pattern in different parts of the world.

Unit V

- Environmental implication of energy use.
- CO₂ emissions, global warming.
- Air and thermal pollution.
- Radioactive waste and radioactivity from nuclear reactors.
- Impact of large-scale exploitation of Solar, Wind, Hydro and Ocean energy.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
Environmental Biology (SPECIAL PAPER)
PRACTICAL
Course Code ZOO C 326
L T P C
0 0 2 1

- Social organization.
- Methods for calculation of population density.
- Different types of ecological pyramids.
- Experiment to demonstrate green house effect.
- Resources & their conservation.
- Estimation of alkali metals in various samples by flame-photometry.
- Water analysis for physico-chemical characteristics.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
Environmental Biology (SPECIAL PAPER)
PRACTICAL
Course Code ZOO C 328
L T P C
0 0 2 1

- A visit to aquatic ecosystem and methods for water and plankton collection
- Plankton identification and quantification from river / lake water samples. 2
- Vegetation studies by line, quadrates and belt transect methods and their analysis
- Studies on different types of eco-system models.
- Food chains and food webs in different eco systems.
- Light as limiting factor in photosynthesis.
- Different biogeochemical cycles.
- Interspecies relationships: prey-predator relation, mutualism, commensalisms & parasitism etc.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) III
STRUCTURE & FUNCTION OF INSECTS
Course Code ZOO C 325

Theory

L T P C

4 0 0 4

Unit – I

Head: Segmentation, structure, endoskeleton, antenna

Mouth: Structure and mechanism of feeding, Types of mouth parts

Thorax: Structure, endoskeleton, structure and modification of legs

Wings: Origin, structure, modification and function of wings

Unit – II

Integument: Structure and chemistry

Abdomen: Structure, pregenital appendages, cerci and external genitalia

Digestive system: Structure and anatomy of the alimentary canal

Unit – III

Respiratory system: Structure in aquatic and terrestrial insects

Circulatory system: Circulatory organs, types and functions of hemocytes

Excretory system: Structure of excretory organs.

Unit – IV

Nervous system

Neuron endocrine system: Structure of neuroendocrine glands, structure and role of hormones, Endocrine control of metamorphosis and reproduction

Sense organs: photoreception, mechanoreceptor and chemoreception, sound production in insects

Unit – V

Reproductive System: structure of male and female reproductive system

Embryology: Pre and post embryonic development. Types of larvae and pupae, type of metamorphosis, diapauses

12 hours/unit

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Course Code ZOO C 326
L T P C
0 0 2 1

List of practical

1. Types of antenna and mouth parts
2. Different types of wings, tegmina, hemielytra, different types of wings venation.
Male genitalia: Grasshopper and coleoptera
Female genitalia: Grasshopper, Gryllus, Coleoptera
3. Sting of honey bee and wasp
4. Preparation of pericardial cells, oenocytes and nephrocytes
5. Different types of spiracles, opening and closing mechanism respiratory organs in aquatic insects
6. Auditory and sound producing organs
7. Neuroendocrine system of cockroach, grasshopper and bugs
8. Sympathetic and central nervous system of the above mentioned insects
9. reproductive system of male and female insects

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) IV
INSECT TAXONOMY AND ECOLOGY
Course Code ZOO C 327

Theory

L T P C

4 0 0 4

Unit – I

Origin and evolution of insects

Molecular markers in insects: Classes of molecular marker

Classification of insects up to orders following Imms revised by Richards and Davis Vol. I & II

Unit – II

Classification up to super families following Imms revised by Richards and Davis Vol. I & II

Apterygota: *Thysanura*, *Diplura*, *Protura*, *Collembola*

Pterygota: Palaeoptera, Odonata

Orthopteroid: *Orthoptera*

Unit – III

Classification up to superfamilies:

Orthopteroid: Dictyptera, Isoptera

Hemipteroid: Hemiptera (Homoptera, Heteroptera)

Neuropteran: Coleoptera

Panorgod insects: Diptera, Lepidoptera, Hymenoptera

Unit – IV

Insects in medical, veterinary sciences: Common vector insects, their mode of transmission, life cycle, diseases & control

Insect in forensic and forest sciences: Common insects & their life cycle

Unit – V

Principles of insect ecology

Effect of temperature, humidity and light on the biology of insects

Social behaviour of insects: migration, adaptation and distribution

12 hours/unit

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Insect Taxonomy and Ecology
Course Code ZOO C 328
L T P C
0 0 2 1

List of practical

1. Collection
2. Identification
3. Classification of insects belonging to the different orders as follows:
Apterygota: *Thysanura*, *Diplura*, *Protura*, *Collembola*
Pterygota: Palaeptera, Odonata
Orthopteroid: Orthoptera
Orthopteroid: Dictyoptera, Isoptera
Hemipteroid: Hemiptera, Isoptera
Neuropteran: Coleoptera
Panorgod insects: Diptera, Lepidoptera, Hymenoptera
4. Practical on molecular taxonomy
5. Effects of abiotic factors like temperature, humidity and light on insects.

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
FISH (SPECIAL PAPER) III
FISH STRUCTURE AND FUNCTION
Course Code ZOO C 325
L T P C
4 0 0 4

Unit 1: Skin & their derivatives

- 1) Structure
- 2) Types of scale & development
- 3) Colour change mechanism
- 4) Light producing organs
- 5) Poison glands
- 6) Electric organs

Unit 2 : Skeleton structure

- 1) Jaws and Jaws suspension
- 2) Fins & origin of the paired fins
- 3) Skull, vertebral column, girdles

Unit : 3 Circulatory systems

- 1) Types of heart in fishes
- 2) Composition of blood
- 3) Gill, circulation in fishes

Unit 4: Respiratory system

- 1) Structure of gill in fishes
- 2) Air breathing fishes
- 3) Physiology of respiration

Unit 5: Excretion & Osmoregulation

- 1) Osmoregulation in fish
- 2) Structure of kidney in fish & physiology of excretion

12 hours/unit

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
FISH (SPECIAL PAPER) IV
FISH ANATOMY & PHYSIOLOGY
Course Code ZOO C 327
L T P C
4 0 0 4

Unit 1 : Reproduction

- 1) Mode of reproduction in fishes
- 2) Male & female reproductive system
- 3) Parental care and sexual dimorphism in fishes

Unit 2: Nervous system & sense organs

- 1) Brain structure
- 2) Autonomic and peripheral nervous system
- 3) Cutaneous sense organs, eye
- 4) Acoustico-lateral line system in fish

Unit 3rd: Endocrine systems

- 1) Pituitary gland
- 2) Thyroid
- 3) Ultimobranchial glands
- 4) Adrenal gland
- 5) Sex glands

Unit 4th: Embryology

- 1) Fertilization
- 2) Cleavage
- 3) Gastrulation
- 4) Organogenesis

Unit 5th: Ecology

- 1) Ecological factors
- 2) Deep sea adaptation
- 3) Hill stream fishes
- 4) Ecological classification of fish
- 5) Migration in fishes
- 6) Age determination in fish

12 hours/unit

M.Sc. COURSE, SESSION – 2016–17
M. Sc. III Semester
FISH (SPECIAL PAPER) PRACTICAL
Course Code ZOO C 326 & ZOO C 328
L T P C
0 0 2 1

List of Practical

1. Dissections:
 - a. Major Dissection:
 - i. Cranial nerves of Wallago and Scoliodon
 - ii. Internal ear, air bladder connection in Mystus and Wallago
 - b. Minor Dissection:
 - i. Afferent arteries of Scoliodon
 - ii. Cranial nerves of Torpedo and Trygon
 - iii. Weberian ossicles of Clarias
2. Age determination in Fish
3. Sexual dimorphism in Fish
4. Modification in digestive system as per the feeding behavior in Fish
5. Experiments on induced breeding
6. Mounting (Permanent): ctenoid and cycloid scales
7. Study of histological slides of various tissues of Fish
8. Microtomy:
 - a. Section cutting of various tissues of fish
 - b. Serial T. S. of fish embryo
 - c. Alizarin preparation of fish

M.Sc. COURSE, SESSION - 2016-17
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 322 A
Molecular Reproduction & Development
Theory
L T P C
2 0 0 2

Unit I: Male reproductive physiology

- 1.1 Overview of spermatogenesis and male infertility factors

Unit II: Female reproductive physiology

- 2.1 Overview of oogenesis and factors affecting female fertility regulation

Unit III: Development

- 1.1 Principles of animal development
- 1.2 Maternal information
- 1.3 Induction and regulation of gene expression during development

Unit IV: Developmental genetics

- 4.1 Organization of human genome
- 4.2 pattern of mendelian inheritance
- 4.3 genomic imprinting

Unit V: Biochemical basis of genetic diseases

- 1.1 Human genetic disorders
- 1.2 Genetics of childhood cancer
- 1.3 Genetic counselling and prenatal diagnostics

6 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Course Code ZOO E 322 B
L T P C
0 0 2 1

1. Basic evaluation of male and female reproductive tract in a mammalian model
2. Introduction to human genome mapping
3. Chromosomal analysis using software interface

M.Sc. COURSE, SESSION - 2016-17
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 323 A
Molecular Taxonomy and DNA Barcoding
Theory
L T P C
2 0 0 2

Unit 1.0: Basics of Molecular Taxonomy

- 1.1 Description, Illustration and communicating molecular biodiversity
- 1.2 DNA barcode for Tree of Life

Unit 2.0: Molecular Taxonomy tools and Protocols

- 2.1 Introduction of mitochondrial DNA for molecular taxonomy
- 2.2 Techniques of extraction of mDNA.
- 2.3 Amplification technique of markers
- 2.3 Quantification and documentation of DNA and PCR product

Unit 3.0: Barcode analysis Software

- 3.1 Introduction of alignment of sequence
- 3.2 Phylogenetic analysis of ecological communities using DNA barcode

Unit 4.0: Laboratory Information Management System (LIMS) for DNA Barcoding

Unit 5.0: Introduction of Barcode of Life Data Base (BOLD)

6 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Molecular Taxonomy and DNA Barcoding
Course Code ZOO E 323 B
L T P C
0 0 2 1

- 1: Collection and preservation of biological Specimens for Molecular studies.
- 2: Extraction and Quantification of mDNA of preserved speccimen
- 3: Amplification of *coi* gene.
- 4: Bioinformatics based sequence assembly, alignment and analysis.

M.Sc. COURSE, SESSION – 2016-17
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 324 A
Free Radicals, Oxidative Stress and Antioxidants
Theory
L T P C
2 0 0 2

Unit 01 : Introduction

- 1.1 General aspects of Oxidative stress;
- 1.2 Types of free radicals and their formation;
- 1.3 Reactive oxygen species (ROS)/ Reactive Nitrogen species (RNS);
- 1.4 Interaction with biological molecules.

Unit 02 : Antioxidant Mechanisms

- 2.1 Mechanisms of antioxidant action;
- 2.2 Repair systems and inducible defenses against oxidant stress;
- 2.3 Vitamins and antioxidant enzymes.

Unit 03: Oxidative Stress: Molecular mechanisms and biological effects

- 3.1 Free radical mediated damage to biomolecules
- 3.2 Mitochondrial biology and oxidative stress
- 3.3 Oxidative stress in Cancer Biology.

Unit 04 : Techniques to Analyse Free Radicals

- 4.1 Electron spin resonance (ESR) or electron paramagnetic resonance (EPR) spectroscopy;
- 4.2 Dichlorofluorescein diacetate (DCF-DA), Diaminofluorescein diacetate (DAF-2DA), Dihydroethidium (DHE) dyes
- 4.3 Assays of antioxidant enzymes.

Unit 05 : Free Radicals in Health and Disease

- 5.1 Toxicity of oxygen;
- 5.2 Pathological systems and toxic responses;
- 5.3 Pathological and Physiological Significance.

Suggested Readings:

- 1. An introduction to Free Radical Chemistry by A. F. Parsons, 2000.
- 2. Free Radicals: An Introduction by A. F. Trotman-Dickenson, 1959.
- 3. Cellular antioxidant defence mechanisms by Ching Kuang Chow, 1988.
- 4. Free Radicals, oxidative stress and antioxidants. Pathological and physiological significance. Edited by Tomris Ozben. NATO ASI Series, Series A: Life Sciences Vol. 296.
- 5. Laboratory Techniques in biochemistry and molecular biology by C.A. Rice-Evans, A.T. Diplock, M.C.R. Symons.

6 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Course Code ZOO E 324 B
L T P C
0 0 2 1

Practical Course:

1. Detection of free radicals (OH⁻, NO) by fluorescence microscopy.
2. Antioxidant enzyme assays by ELISA.

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG IV SEMESTER

SESSION – 2016-17



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M. Sc. IV Semester			
Core Course Code		Paper Title	Credits
ZOO C 421	Theory	Structure & Function of Vertebrates	04
ZOO C 422	Practical	Structure & Function of Vertebrates	01
ZOO C 423	Theory	Environmental Biology and Ethology	04
ZOO C 424	Practical	Environmental Biology and Ethology	01
ZOO C 425	Theory	Cytogenetics	04
ZOO C 426	Practical	Cytogenetics	01
ZOO C 427	Theory	Molecular Biology	04
ZOO C 428	Practical	Molecular Biology	01
ZOO C 425	Theory	Environmental Sciences (Environmental Pollution)	04
ZOO C 426	Practical	Environmental Sciences (Environmental Pollution)	01
ZOO C 427	Theory	Environmental Sciences (Environmental Management)	04
ZOO C 428	Practical	Environmental Sciences (Environmental Management)	01
ZOO C 425	Theory	Physiology & Biochemistry of Insects	04
ZOO C 426	Practical	Physiology & Biochemistry of Insects	01
ZOO C 427	Theory	Applied Entomology and Insect Ecology	04
ZOO C 428	Practical	Applied Entomology and Insect Ecology	01
ZOO C 425	Theory	Taxonomy, Systematic and Ecology of Fishes	04
ZOO C 426	Practical	Taxonomy, Systematic and Ecology of Fishes	01
ZOO C 427	Theory	Pisciculture and Economic Importance of Fisheries	04
ZOO C 428	Practical	Pisciculture and Economic Importance of Fisheries	01
ZOO E 429 A	Theory	Elective	02
ZOO E 429 B	Practical	Elective	01
Total Credits			23

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
General Paper – I
Structure and Function in Vertebrates
Course code ZOO C 421

Theory

L T P C

4 0 0 4

Unit – I

Classification of Vertebrates
Origin of Vertebrates
Comparative account of Petromyzontia and Myxinoidea
Characters and Classification of Placodermi
General organization and Classification of Elasmobranchii
General organization and Classification of Osteichthyes
Brief account of Dipnoi, Holocephali

Unit – II

General organization and Classification of Amphibians, Limbless Amphibian
Origin of Amphibia
General organization and Classification of Reptilians
Brief account of Chelonia, Dinosaurs, Crocodiles, Lizards and snakes

Unit – III

General organization and Classification of Birds
Origin of Birds
Flight adaptation in Birds
Brief account of Archaeopteryx and Flightless Birds

Unit – IV

Characters and Classification of Mammals
Brief account of Prototheria, Metatheria, and Eutheria

Unit – V

Brief account of-
Primate, Chiropterans, Cetacean, Carnivores, Proboscidea, Rudentia
Aquatic Mammals, Stomach in Ruminants

9 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
General Paper – I, PRACTICAL
Structure and Function in Vertebrates
Course code ZOO C 422
L T P C
0 0 2 1

List of Practical

1. Dissections: Rat/mouse/Scoliodon – Digestive, Reproductive, Arterial, Venous systems, neck nerves.
2. Museum specimens and slides
Protochordates – Salpa-sexual, Salpa-asexual, Botryllus, Herdmania, Fishers
3. Museum Specimens (Protochordates to mammals)
4. Slides: sections of skin, alimentary canal, lungs, gills, kidney, ovaries and testes of different groups of vertebrates.
5. Dissection: (major and minor in Scoliodon/electric ray)
 - a. Fish a) afferent blood vessels
 - i. b) Efferent blood vessels
 - b. Frog c) Cranial Nerves
 - i. d) Spinal nerves
 - ii. e) Digestive system
 - iii. f) Urinogenital system
 - iv. g) Sense organs e.g. Eye, Internal ear, Lateral line
6. General anatomy of Herdmania
7. Preparation of permanent slides of test and pharyngeal wall of Herdmania, Amphioxus: anterior region: w.m., different types of scales in fishes in fishes, ampulla of Lorenzini.
8. Microtomy to prepare stained, permanent mounts of different organs e.g. skin, liver, lung, kidney and gonads etc.
9. Skeletal system: fish, amphibian, reptilian, aves and mammal.
10. Accessory respiratory organs in fishes.
11. Blood supply to air tube in *Heteropneustes*.

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
General Paper – II, Theory
Environmental Biology and Ethology
Course code ZOO C 423
L T P C
4 0 0 4

Unit I: Environmental health and toxicology

1. Introduction to Toxicology
2. Kinds of Toxic Substances
3. Toxicity-Influencing Factors
4. Exposure to Toxic Substances
5. Dose–Response Relationships
6. Xenobiotic and Endogenous Substances
7. Toxicification and Detoxification
8. Synergism, Potentiation, and Antagonism
9. Behavioral and Physiological Responses
10. Reproductive and Developmental Effects

Unit II : Conservation and management of natural resources

1. Natural resources conservation and Management
2. Biodiversity: Need for conservation of biodiversity
3. Benefits and threats to biodiversity
4. Endangered species management and biodiversity protection
5. Alternative sources of Energy

Unit III : Global Environmental Issues

1. Global Warming and Global Cooling
2. Green House Effect
3. Ozone Depletion
4. Acid Rain
5. Sea level rise
6. Antarctica: Environmental politics & resource development regimes

Unit IV : Environmental Protection and Impact Assessment

1. The Environmental protection Act, 1986
2. Air Pollution Act, 1981 and Motor Vehicle Act, 1988
3. Water Protection Act, 1974
4. The Wildlife Protection Act, 1972
5. Introduction to environmental impact analysis.
6. Environmental impact Statement and Environmental Management Plan.
7. EIA guidelines 1994, Notification of Government of India.
8. Impact Assessment Methodologies.
9. Procedure for reviewing Environmental impact analysis and statement.
10. Guidelines for Environmental audit.

Unit V : Ethology

- Introduction to animal behaviour
- Genetic and neural basis of behavior
- Habitat selection and foraging behaviour

- Animal signals and communication
- Sexual conflict: Parental care, Sexual selection
- Social organization: Theories of social behavior, Altruism

9 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
Environmental Biology and Ethology - Practicals
Course Code ZOO C 424
L T P C
0 0 2 1

List of practical:

1. Field visit to river/lake and water and wastewater treatment plants.
2. Water analysis of municipal and industrial wastes for the detection of DO, BOD, COD, Alkalinity, pH, turbidity, and temperature.
3. Soil analysis for the detection of N, P, & K.
4. Waste water treatment methods.
5. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
6. Biodegradation of pesticides.
7. Models of non-conventional energy resources
8. Wild life: endangered and frightened species
9. Experiment to demonstrate green house effect.
10. Resources & their conservation.
11. Biosphere reserves, National parks and wildlife sanctuaries in India.
12. Demonstration of reflexes in man
13. Study of learning behaviour.
14. Display of electric organ of an electric ray.
15. Demonstration of parental care / nest building / sexual dimorphism.
16. Study of learning behaviour in mice by using a zigzag or T-shaped maze
17. Study of wall-seeking behaviour in mice
18. A field study of play behaviour or parent-young interactions in a troop of rhesus monkeys
19. A field study of foraging or trail making behaviour in a seed harvester or predatory ant species

Suggested Reading Material

1. Alcock : Animal Behaviour: An Evolutionary Approach (7th ed 2005, Sinaur).
2. Bolhuis & Giraldeau: The Behavior of Animals: mechanisms, function, and evolution (2005, Blackwell)
3. Drickamer, Vessey & Jakob: Animal Behavior: Mechanisms, Ecology, Evolution (2007, McGraw-Hill)
4. Krebs & Davis: Behavioural Ecology. (3rd ed 1993, Blackwell)
5. Lehner: Hand Book of Ethological Methods.(2nd ed 1996, Garland)
6. Manning & Dawkins: An introduction to Animal Behaviour (5th ed 1998, Cambridge Univ. Press)

M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) III
Cytogenetics: Course code ZOO C 425

Theory

L T P C

4 0 0 4

Unit – I

Structure of eukaryotic chromosome
Euchromatin and Heterochromatin
Organization of genes and chromosomes

Unit – II

Normal human karyotype, G – banding
Human sex chromosomes and determination of sex
Human chromosomal abnormalities: Sex chromosomal anomalies, autosomal anomalies
Structure of chromatin and chromosomes

Unit – III

Genetic map of the human chromosome
Somatic cell genetics, hybrid and their applications, heterokaryon
Cytogenetic effect of ionizing and non – ionizing radiation

Unit – IV

Genetic transfer in bacteria (bacterial recombination): conjugation, transduction, transformation
Types of bacteriophages
Conformations of nucleic acids (A-, B-, Z-DNA, t-RNA, micro-RNA) and their stability, Cvalue
Paradox
Mobile DNA, transposons and repetitive DNA

Unit – V

The genetic code, codon – anticodon recognition
Structure and types of RNA
Properties of t – RNA for pairing and proof reading
Concept of gene therapy

12 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) IV
Molecular Biology: Course code ZOO C 427

Theory

L T P C

4 0 0 4

Unit – I

DNA replication: unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons
DNA damage and repair mechanisms
Transcription (gene expression): mechanism and regulation, transcription factors and machinery
RNA processing, RNA editing and splicing
Post transcriptional modifications

Unit – II

Translation: mechanism and regulation
Post translational modifications
Control of gene expression at transcription and translation levels
Regulation of gene expression by non-coding RNAs
Antisense molecules in regulation of gene expression and gene silencing, CRISPR-CAS SYSTEM

Unit – III

Molecular markers: RFLPs, RAPDs, Minisatellites, Microsatellites
Genetic maps of mouse & fruitfly using molecular markers
Cytogenetics maps using molecular markers: flow sorting, PFGE, microdissection, radiation hybrids
Physical maps using molecular markers: deletions ISH, YAC

Unit – IV

Gene cloning techniques, Enzymes used in genetic engineering
Cloning vectors: plasmids, phages, cosmids, phagemids, viruses, transposons, YAC, MAC
PCR: working mechanism and applications

Unit – V

DNA fingerprinting, DNA footprinting
DNA isolation and sequencing
Southern, northern and western blotting, Dot blots and Slot blots
Gene transfer methods in animals: transgenic animals

12 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) PRACTICAL
Course code ZOO C 426
L T P C
0 0 2 1

List of Practical

1. UV Spectrophotometer estimation of DNA, RNA and protein
2. Isolation and purification of genomic DNA & RNA and plasmid
3. Isolation and separation methods for analysis of proteins
4. Separation of proteins by SDS-PAGE
5. Separation of DNA by agarose gel electrophoreses

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) PRACTICAL
Course code ZOO C 428
L T P C
0 0 2 1

List of Practical

1. Study of normal human karyotype
2. Study of chromatin by Feulgen staining
3. Demonstration of PCR
4. Primer and siRNA designing
5. Cloning using bacterial plasmids

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
Environmental Sciences(Environmental Pollution) (SPECIAL PAPER) III
Course code ZOO C 425

Theory

L T P C

4 0 0 4

Unit-I

1. Air : Natural and anthropogenic sources of pollution. Primary and Secondary pollutants. Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Methods of monitoring and control of air pollution SO₂, NO_x, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain. Air Quality Standards.
2. Water : Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard.
3. Soil : Physico-chemical as bacteriological sampling as analysis of soil quality. Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro-organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil.

Unit-II

1. Noise : Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health.
2. Marine : Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system-coastal management.
3. Radioactive and Thermal Pollution.

Unit-III

1. Introduction to environmental impact analysis.
2. Environmental impact Statement and Environmental Management Plan.
3. EIA guidelines 1994, Notification of Government of India.
4. Impact Assessment Methodologies.
5. Procedure for reviewing Environmental impact analysis and statement.
6. Guidelines for Environmental audit.

Unit-IV

1. Introduction to Environmental planning.
2. Base line information and predictions (land, water, atmosphere, energy, etc.).
3. Restoration and rehabilitation technologies.
4. Landuse policy for India.
5. Urban planning for India.
6. Rural planning and landuse pattern.

Unit-V

1. Concept and strategies of sustainable development.
2. Cost-Benefit analysis.
3. Environmental priorities in India and sustainable development.

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
Environmental Sciences (Environmental Management)(SPECIALPAPER) IV
Course code ZOO C 427

Theory

L T P C

4 0 0 4

Unit I

1. Sources and generation of solid wastes, their characterization, chemical composition and classification.
2. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes)
3. Recycling of waste material.
4. Waste minimization technologies.
5. Hazardous Wastes Management and Handling Rules, 1989.

Unit II

1. Resource Management, Disaster Management and Risk analysis.
2. Environment protection-issues and problems.
3. International and National efforts for Environment Protection.
4. Provision of Constitution of India regarding Environment (Article 48A and 58A).
5. Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control.

Unit III

1. Wildlife Protection Act, 1972 amended 1991.
2. Forest Conservation Act, 1980.
3. Indian Forests Act (Revised) 1982.
4. Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988.
5. The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975.
6. The Environment (Protection) Act, 1986 and Rules 1986.
7. Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

Unit IV

1. Environmental Education and Awareness. Environmental Ethics and Global imperatives.
2. Global Environmental problems-ozone depletion, global warming and climatic change.
3. Current Environmental issue in India. In context to Narmada Dam and Tehri Dam etc.
4. Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil.
5. Waste lands and their reclamation.
6. Desertification and its control.
7. Vehicular pollution and urban air quality.

Unit V

1. Depletion of Nature resources.
2. Biodiversity conservation and Agenda – 21.

3. Waste disposal, recycling and power generation, Fly ash utilization. Water Crises- Conservation of water.
4. Environmental Hazards.
5. Eutrophication and restoration of Indian lakes. Rain water harvesting. Wet lands conservation.
6. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic).

12hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
Environmental Sciences (SPECIAL PAPER)
PRACTICAL
Course code ZOO C 426
L T P C
0 0 2 1

List of practical:

1. Comparative analysis of air sampling from clean and polluted area using key parameters.
2. Collection and Interpretation of weather data.
3. Field visit to river/lake and water and wastewater treatment plants.
4. Water analysis of municipal and industrial wastes for the detection of DO, BOD, COD, CO₃, HCO₃, Cl₂, Alkalinity, pH, turbidity, and temperature.
5. Soil analysis for the detection of N, P, K, NO₃, SO₄, Cl₂, CO₃ etc.
6. Waste water treatment methods.
7. Detection of heavy metals in water samples.

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
Environmental Sciences (SPECIAL PAPER)
PRACTICAL
Course code ZOO C 428
L T P C
0 0 2 1

1. Detection of pesticide residues by TLC.
2. Calculation of LC_{100} , LC_{50} , LC_0 , sub-lethal concentration, LD_{100} , LD_{50} , LD_0 and sub-lethal doses.
3. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
4. Biodegradation of pesticides.
5. Models of non-conventional energy resources
6. Vermiculture and composting.
7. Wild life: endangered and frightened species
8. Biosphere reserves, National parks and wildlife sanctuaries in India.

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
FISH (SPECIAL PAPER) III
TAXONOMY, SYSTEMATIC AND ECOLOGY OF FISHES
Course code ZOO C 425
Theory
L T P C
4 0 0 4

Unit I

Classification of fishes upto families

Unit II Molecular taxonomy

Unit III : General characters and classification of economic importance

Fresh water fishes of India

Family: Siluridae

Family : Cyprinidae

Unit IV Fisheries

Type of fisheries

Riverine fisheries in India

Pond and lake fisheries

Estuarine fisheries

Marine fisheries Fresh water fisheries

Unit V

Preparation and management of fresh pond

Dry and wet bundh method of fisheries

Induced breeding method

12 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
FISH (SPECIAL PAPER) IV
PISCICULTURE AND ECONOMIC IMPORTANCE OF FISHES
Course code ZOO C 427
Theory
L T P C
4 0 0 4

Unit I

Composite fish culture
Transport of fish seed
Exotic fishes
Weeds and their control

Unit II

Nets and gears for fisheries

Unit III

Aquarium keeping setting
Fish diseases

Unit IV

Preservation of fishes
By product of fish industry

Unit V

Marketing of fishes
Fish genetic resources
Threatened aquatic species in India and world
Endangered species as per the guidelines of IUCN
Cryopreservation of sperm, eggs and embryos

12 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
FISH (SPECIAL PAPER) PRACTICAL
Course code ZOO C 426 & ZOO C 428
L T P C
0 0 2 1

List of Practical

Systematic

Collection and Identification of fishes (local fauna) with the help of fish fauna

Identification of various weeds of fish pond

Fish

Study of endoskeleton of Labeo/Catla and Wallago/Mystus

Study of kidney and single nephron in a local fish

Experimentation:

Experiment of colour change mechanism in fish

Schooling behaviour of fish

Gonadectomy and spinalectomy in fish

Effect of respiratory depressant in a fish

Determination of oxygen consumption in fish

Dissections:

Major Dissection:

Cranial nerves of *Mystus*

Lateral line system of *Scoliodon*

Internal ear of *Scoliodon*

Minor Dissection:

Air tube and its blood supply in *Heteropneustes*

Mounting:

Placoid scale of *Scoliodon*

Ampulla of Lorenzini of *Scoliodon*

Microtomy: serial T.S. of fish embryo

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) III
Physiology and Biochemistry of Insects
Course code ZOO C 425

Theory

L T P C

4 0 0 4

Unit – I

Integument: Moulting and sclerotization

Physiology of digestion and assimilation of nutrients

Unit – II

Physiology of circulation and biochemistry of haemolymph

Physiology of respiration in terrestrial and aquatic insects

Unit – III

Physiology of excretion

Physiology of reproductive system

Physiology of nervous system

Unit – IV

Insect immunity: Cellular and humoral

Coloration in insects

Bioluminescence: Structure of bioluminescent organs and physiology of bioluminescence.

Unit – V

Carbohydrate, protein and lipid metabolism

Detoxification mechanism in insects

Physiology and biochemistry of ageing

12 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Physiology and Biochemistry of Insects
Course code ZOO C 426
L T P C
0 0 2 1

List of practical

1. Salivary glands of *Drosophila* larvae and *Chironomus* larvae.
2. Physiology experiments to show: (i) functions of malpighian tubules (ii) insects produce moisture from the spiracles during flight
3. Study of histochemical techniques in insect tissues
4. Study of protein, carbohydrate and lipid estimation in insect tissues
5. Determination of haemocyte count of a given insect
6. Identification of different types of haemocytes

M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) IV
Applied Entomology & Insect Ecology
Course code ZOO C 427

Theory

L T P C

4 0 0 4

Unit – I

Basic principles of insect control

Chemical control: insecticides, their classification and mode of action

Insect resistance to insecticides, 3rd generation pesticides, chemosterilants and radiations

Unit – II

Insect pest control: role of hormones, pheromones, antifeedents, attractants, repellents, plant products

Biological control: Principle, procedure, success and limitation

Unit – III

Beneficial insects: Life cycle & Polymorphic forms of Honey Bee & Termite

Importance of beneficial insects: apiculture, sericulture, lac culture

Integrated pest management (IPM)

Unit – IV

Biology and Control of insect pests of:

Cash crop: soybean, sugar cane

Oil seeds: cotton, sunflower, mustard

Cereal: pea, arhar, masoor, moong

Unit – V

Stores grain pests wheat, gram and rice

Vegetable: cabbage, bhindi, brinjal, tomato, potato

Fruits: mango, citrus, papaya

12 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Applied Entomology & Insect Ecology
Course code ZOO C 428
L T P C
0 0 2 1

List of practical:

1. Collection, identification and classification of insects belonging to the different orders
2. Collections of insects of medical importance and their life cycle
3. Collection of polymorphic forms of honey bee and termites
4. Effect of an insecticides on a household pest

M.Sc. COURSE, SESSION - 2016-17
PG FOURTH SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 422 A

Molecular Medicine

Theory

L T P C

2 0 0 2

Unit I: Technology & Society

- 1.1 Historical perspectives
- 1.2 evolution & dynamics of modern biology

Unit II: Biomedical basis of disease: From Gene to Protein to Disease

- 2.1 Cause and molecular/cellular progression of key diseases including infectious
- 2.2 inherited diseases
- 2.3 emphasising specially on cancer

Unit III: Analytical Technology

- 3.1 Basic principles of DNA sequencing
- 3.2 flow cytometry
- 3.3 laser scanning confocal microscopy
- 3.4 Real Time PCR

Unit IV: Genetic & Molecular Epidemiology

- 4.1 Basic principles
- 4.2 Bioinformatic tools
- 4.3 key tests and data interpretation using cutting-edge platforms

Unit V: Translational Research

- 5.1 Integrating pharmacogenetic approaches to health-care systems

6 hours/unit

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 422 B
L T P C
0 0 2 1

Practical Course:

1. Hands on experience to basic molecular tools and techniques
2. Medline database search and basic bioinformatics.

M.Sc. COURSE, SESSION - 2016-17
PG FOURTH SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 423
Methods in Molecular Biology

Theory

L T P C

2 0 0 2

Unit-I: Methods in Protein Biochemistry

- 1.1 Protein purification and separation methods
- 1.2 Application of centrifugation techniques
- 1.3 Chromatographic separation techniques
- 1.4 Electrophoresis – principle and methods

Unit-II: Protein Purification and Characterization

- 2.1 Protein isolation from plants and animal tissues, and cell cultures
- 2.2 Protein quantification
- 2.3 Catalytic identification of enzymes on electrophoresis

Unit-III: Methods in Nucleic Acids - DNA

- 3.1 DNA isolation from plants and animal tissues, and cell cultures
- 3.2 DNA purification methods
- 3.3 DNA quantification
- 3.4 Agarose gel electrophoresis – principle and methods (DNA and RNA)

Unit-IV: Methods in Nucleic Acids - RNA

- 4.1 Total RNA isolation from plants and animal tissues, and cell cultures
- 4.2 RNA purification and quantification
- 4.3 Agarose gel electrophoresis for RNA

Unit-V: Basics of gene expression analysis

- 5.1 Polymerase chain reaction – principles and methods
- 5.2 Real-Time PCR
- 5.3 Application of RNA for PCR amplification in analysis of gene expression

6 hours/unit

Suggested Reading Material

- 1. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John M. Walker.
- 2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.

M.Sc. COURSE, SESSION - 2016-17
M. Sc. IV Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 423 B
L T P C
0 0 2 1

List of Practical:

1. Demonstration of spectrophotometry
2. Demonstration of chromatographic techniques
3. Isolation of Protein from plant/animal tissues
4. Demonstration of protein precipitation
5. Estimation of protein by spectrophotometer
6. Separation of proteins by SDS-PAGE
7. Isolation of nucleic acids from plant/animal tissues
8. Estimation of nucleic acids by spectrophotometer
9. Separation of nucleic acids by agarose gel electrophoresis
10. Demonstration of PCR and RT-PCR

M.Sc. COURSE, SESSION – 2016-17
PG FOURTH SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 424 A

Bioinformatics

Theory

L T P C

2 0 0 2

Unit 01: Introduction

- 1.1 History and Scope of Bioinformatics
- 1.2 Definitions of Bioinformatics
- 1.3 Importance of Bioinformatics

Unit 02: Computers, Internet, World Wide Web and NCBI

- 2.1 Computers and Programs
- 2.2 Internet
- 2.3 World Wide Web & Browsers
- 2.4 EMBnet& NCBI

Unit 03: DNA, RNA and Proteins

- 3.1 Principles of DNA sequencing
- 3.2 Principles of RNA sequencing
- 3.3 Principles of Protein sequencing
- 3.4 Gene & Protein Expression Analysis
- 3.5 DNA microarray
- 3.6 Human Genome Project

Unit 04: Databases, Tools and their Uses

- 4.1 Importance of databases
- 4.2 Nucleic acid sequence databases
- 4.3 Protein sequence databases
- 4.4 Primary sequence databases- GenBank; NCBI; EMBL; ODBI
- 4.5 Subsidiary sequence databases-SWISS-PROT; TrEMBL; UniProt
- 4.6 Organism specific resources-OMIM; Unigene
- 4.7 Database Formats; Medline; PubMed; Web of Science
- 4.8 Uses of databases

Unit 05: Analyzing and Retrieving Databases

- 5.1 Sequence alignment methods
- 5.2 Pairwise and Multiple sequence alignment
- 5.3 Analyzing Protein sequences
- 5.4 Analyzing DNA sequences
- 5.5 Analyzing RNA sequences
- 5.6 BLAST; ClustalW
- 5.7 Phlogenetic Trees-Phylip

6 hours/unit

Suggested Readings:

1. "Understanding Bioinformatics" by Marketa J. Zvelbil; Publisher-Garland Science; ISBN-10:0815340249.
2. "Introduction to Bioinformatics" by Arthur M. Lesk; Publisher-Oxford University Press; ISBN-10:0199208042.
3. "Basic Bioinformatics" by S. Iganacimuthu; Publisher-Narosa; ISBN-978-81-7319-540-9.
4. "Bioinformatics for Dummies" by Jean-Michel Claverie, Publisher-For Dummies; ISBN-10:0470089857.

M.Sc. COURSE, SESSION – 2016-17
M. Sc. IV Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 424 B
L T P C
0 0 2 1

List of Practical:

1. Demonstration of PubMed in searching scientific literature using authors name, fields, limits etc.
2. Demonstration of BLAST in comparing Protein Sequences.
3. Demonstration of ClustalW in Multiple sequence alignment.
4. Demonstration of Rasmol in Protein structure visualisation.
5. Designing PCR primers.

M.Sc. I Sem (ELECTIVE COURSE)

**M.Sc. COURSE, SESSION - 2014-15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 129 A
Cancer Biology & Therapeutics**

Theory

L T P C

2 0 0 2

6 hours/unit

Unit I: Origin, progress and dissemination of the disease, common forms and their diagnosis.

Unit II: Genetic and epigenetic association

1.1 Heritable traits

1.2 histone modifications and DNA methylation

1.3 micro RNAs and their role

Unit III: Radio-protectors, immuno-modulators and chemo-prevention

3.1 Anti-carcinogenicity of novel drug prototypes isolated from herbal/plant sources

Unit IV: Cellular therapy

4.1 Basic introduction to cellular engineering methods including Dendritic cell based nano-therapeutics

Unit V: Translational oncology

5.1 Basic understanding to epithelial-mesenchymal transition

5.2 Stem cell therapeutics

5.3Pharmaco-surveillance and nano-medicine

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 129 B
Cancer Biology & Therapeutics
Practical
L T P C
0 0 2 1

LIST OF PRACTICALS

1. Cancer cell culture
2. Dendritic cell culture
3. Immunophenotyping
4. Isolation and characterization of active principles from herbal sources
5. Preparation of molecular vectors and characterization

M.Sc. COURSE, SESSION - 2014-15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 129 A

Vermibiotechnology

Theory

L T P C

2 0 0 2

6 hours/unit

Unit 1.0 : Earthworms

- 1.1 Basic structure
- 1.2 Life cycle
- 1.3 Life span
- 1.4 Identification of earthworm

Unit 2.0: Ecological Groups of Earthworms

- 2.1 Ecological requirements of earthworms
- 2.2 Earthworm species used in vermiculture

Unit 3.0: Vermicompost

- 3.1 Vermicompost materials
- 3.2 Preliminary treatment of composting materials
- 3.3 Method of vermicompost production
- 3.4 Benefits of vermicompost
- 3.5 Nutrient profile of vermicompost
- 3.6 Problems and their solutions

Unit 4.0: Vermiwash

- 4.1 Composition of vermiwash
- 4.2 Method of preparation
- 4.3 Method of application
- 4.4 Benefits of vermiwash

Unit 5.0: Wormery

- 5.1 Methods to establishment of wormery unit
- 5.2 Harvesting of earthworms
- 5.3 Grading and counting of earthworms
- 5.4 Transportation of live worms and cocoons
- 5.5 Precautions and requirements of wormery
- 5.6 Factors effecting the worm production
- 5.7 Vermi -entrepneurship

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 123 B

Vermibiotechnology

Practical

L T P C

0 0 2 1

LIST OF PRACTICALS

- 1: Collection and Identification of the epigeic earthworm species suitable for vermicomposting.
- 2: Different techniques for developing small and high scale vermireactors.
- 3: Grading and counting of Coccons and their method of transportation.
- 4: Preparation of Vermiwash and Vermimeal.

M.Sc. COURSE, SESSION - 2014-15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 129 A

Neurobiology

Theory

L T P C

2 0 0 2

Unit-I Plasticity of brain and neurogenesis

Unit-II Organization of nervous system

- 2.1 Brain structure
- 2.2 Neurons and glia
- 2.3 Cerebrospinal fluid
- 2.4 Neural network
- 2.5 Blood brain barrier
- 2.6 Autonomic nervous system

Unit-III Axonal and synaptic transmission

- 3.1 Types of neurons
- 3.2 Membrane potential and action potential
- 3.3 Types of synapses
- 3.4 Excitatory and inhibitory post-synaptic potential
- 3.5 Chemical transmission, neurotransmitters (acetylcholine, catecholamines, serotonin and GABA), neuropeptides

Unit-IV 4.1 Molecular basis of learning and memory

- 4.2 Brain and behavior
- 4.3 Brain imaging using CAT, PET and MRI

Unit-V 5.1 Brain aging

- 5.2 Neuropathology and physiology
 - 5.2.1 Strokes
 - 5.2.2 Epilepsy
 - 5.2.3 Alzheimer disease
 - 5.2.4 Huntington disease
 - 5.2.5 Parkinson disease
 - 5.2.6 Hepatic Encephalopathy

Books Recommended

1. Ganong: Review of Medical Physiology (22nd ed 2005, Lang Medical Publications)
2. Guyton and Hall: Text Book of Medical Physiology (11th ed 2006, W.B. Saunders)
3. Keel et al: Samson Wright's Applied Physiology (14th ed 1989, Oxford Press)
4. West: Best and Taylor's Physiological Basis of Medical Practice (11th ed 1981, Williams and Wilkins)
5. Longstaff: Neuroscience (2002, Viva Books)
6. Shepherd: Neurobiology (1994, Oxford Univ Press)
7. Squire et al: Fundamental Neuroscience (2003, Academic Press)
8. Eric Kandel: Principles of Neural Science (2000, Mc Graw Hill)

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15

PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY

Course Code ZOO E 129 B

L T P C

0 0 2 1

LIST OF PRACTICALS

1. Studies on learning and memory in rat/mouse model by Morris-Water-Maze Test or by using a zigzag or T-shaped maze in an animal model of Hepatic Encephalopathy
2. Behavioural analysis through motor function tests (catalepsy test, footprinting test, rotarod test).
3. a). Isolation of neurons and glia by differential centrifugation
b). Characterization of isolated cells types using specific marker

SYLLABUS FOR Ph.D COURSE IN ZOOLOGY

Ph. D. FIRST SEMESTER

SESSION – 2016-17



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)**

DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003

Ph.D. COURSE SYLLABUS 2016-17
DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES
DR. H. S. GOUR UNIVERSITY SAGAR, 470003 (M.P.)

I Semester

Paper Course Code	Paper Title	Credits
Paper I– ZOO C 141	Research Methodology	03
Paper I – ZOO C 142	Research Methodology Practical	01
Paper II – ZOO C 143	Biostatistics and Informatics	03
Paper II– ZOO C 144	Biostatistics and Informatics Practical	01
Paper III– ZOO C 145	Review Writing	04
Paper IV – ZOO C 146	Techniques in Modern Biology	03
Paper IV – ZOO C 147	Techniques in Modern Biology Practical	01
	Total Credits	16

Ph.D. COURSE, SESSION 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO C 141
COURSE TITLE: RESEARCH METHODOLOGY

L	T	P	C
3	0	0	3

Unit - I

Objectives and types of research: Motivation and objectives - Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

Unit - II

Research Formulation: Defining and formulating & development of hypothesis the research problem. Importance of literature review in defining a problem. Primary and secondary sources – reviews, treatise, monographs, patents. Development of working hypothesis.

Unit - III

Research design and methods: Basic Principles, need of research design, features of good design, important concepts relating to research design. Developing a research plan: Exploration, Description, Diagnosis, Experimentation.

Unit - IV

Reporting and thesis writing: Structure and components of scientific reports. Types of report, preparation of technical reports and thesis. Bibliography and referencing. Oral and poster presentations, use of visual aids, importance of effective communication.

Unit - V

Application of results and ethics: Environmental impacts, Ethical issues, ethical committees. Commercialization: Copy right, royalty, intellectual property rights and patent law. Plagiarism, citation and acknowledgement, reproducibility and accountability.

12 hours/month

Ph.D. COURSE SYLLABUS 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO C 142

L	T	P	C
0	0	2	1

- | | |
|-----------------------------------|----------|
| 1. Presentation and Discussion | 50 Marks |
| 2. Reference writing and citation | 20 Marks |
| 3. Sessional (Research Design) | 20 Marks |
| 4. Viva –Voce | 10 Marks |

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Ph.D. COURSE, SESSION 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO C 143
COURSE TITLE: BIOSTATISTICS & INFORMATICS

L	T	P	C
3	0	0	3

Unit – I

Collection, classification & diagrammatic representation of statistical data, frequency and frequency distribution, measures of central tendency: mean, median and mode.

Unit - II

Measures of dispersion: range, mean deviation, variance, standard deviation, standard error, skewness, kurtosis, regression & correlation, chi-square test, student's t-test, Parametric and non-parametric test, ANOVA and other statistical computer packages.

Unit - III

Definition, history, scope and applications of bioinformatics, Biological Databases: primary & secondary databases e.g. GenBank, EMBL, DDBJ, Entrez, OMIM, SWISS-Prot etc. Literature Databases: Open access and open sources, PubMed, PLoS, Biomed Central.

Unit - IV

Sequence alignment methods: pairwise and multiple sequence alignment, analyzing and retrieving databases, database similarity searches: BLAST & FASTA, Phylogenetic tree construction, Gene prediction, Protein and RNA structure prediction.

Unit - V

IPR in Bioinformatics, Computer Science, Medical research, Pharma, Biodiversity, Genetic resources & Biotechnology.

12 hours/month

Ph.D. COURSE, SESSION 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO C 144

L	T	P	C
0	0	2	1

1. Mean, Mode, Median	20 Marks
2. Std. Deviation	10 Marks
3. Graphical presentation	10 Marks
4. Correlation	10 Marks
5. working with excel	10 Marks
6. Arithmetic progression	10 Marks
7. Viva-Voce	10 Marks
8. Record	10 Marks
9. Hard copy submission	10 Marks
Of presentation	

Ph.D. COURSE, SESSION 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO E 146
COURSE TITLE: TECHNIQUES IN MODERN BIOLOGY

L	T	P	C
3	0	0	3

Unit - I

Biochemical and Biophysical Techniques: Purification and characterization of biomolecules - Centrifugation, Ultrafiltration, Spectrophotometric methods, flowcytometry.

Unit - II

Histology and Histochemistry: Fixation and sectioning of tissue, embryos, and cells, Microtomy, Cryotomy. Principles and applications of Immunohistochemistry and Immunofluorescence. Histochemical staining for localization of enzymes, lipids, protein and carbohydrates.

Unit - III

Microscopic techniques: Specimen preparation for electron microscopy, freeze fracturing, freeze etching, negative staining. Principles and applications of SEM, TEM, STEM, Fluorescence microscopy, Confocal microscopy, Microphotography.

Unit - IV

Methods for protein and nucleic acid purification - chromatography. One and two dimensional electrophoresis, agarose gel electrophoresis. Blotting Techniques - Southern, Northern and Western.

Unit - V

Cell & Molecular biology and Genetic Engineering Techniques: Principles and applications of PCR, RT-PCR and ELISA, Fluorescence insitu Hybridization (FISH), DNA sequencing, Protein sequencing, Comet assay, Cell based assays.

12hours/month

Ph.D. COURSE, SESSION 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO E 147

L	T	P	C
0	0	2	1

- | | |
|--------------------------|----------|
| 1. Two working exercises | 50 Marks |
| 2. One writing exercises | 20 Marks |
| 3. Viva-Voce | 10 Marks |
| 4. Sessional | 20 Marks |

Ph.D. COURSE, SESSION 2016–17
DEPARTMENT OF ZOOLOGY
Course Code – ZOO C 145
COURSE TITLE: TECHNIQUES IN MODERN BIOLOGY
COURSE TITLE: REVIEW WRITING

L	T	P	C
2	0	4	4

- | | |
|--------------------------------------|----------|
| 1. Two Hard copies of review article | 15 Marks |
| 2. Hard copy of presentation | 15 Marks |
| 3. Presentation | 50 Marks |
| 4. Viva and discussion | 20 Marks |