

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester I

### ANIMAL DIVERSITY (NON-CHORDATES)

**ZOO/BTCH-CC-102**  
**Credits: 04**

**Time: 60 Hours**  
**Max. Marks: (40+60)**

#### **Unit I: Classification of Invertebrates.**

**15 Hours**

General characters and classification up to class level with distinctive and adaptive features of Protozoa, Porifera, Coelenterata, Platyhelminths, Annelida, Arthropoda, Mollusca and Echinodermata with the suitable examples of each category.

#### **Unit II: Mode of Life in Lower Invertebrates.**

**15 Hours**

Protozoa: -Structure and life cycle of *Amoeba*, *Plasmodium* and *Trypanosoma*.

Porifera: -Canal system and Skeletal system.

Coelenterata: - Polymorphism, Coral and Coral reefs.

Ctenophora: -General organization and Evolutionary significance.

Platyhelminths: - Life cycle and pathogenicity of *Taenia solium*, and *Fasciola hepatica*.

#### **Unit III: Functional Anatomy of Higher Invertebrates**

**15 Hours**

Annelida:-Digestive System, Excretory System, Reproductive System of *Pheretima* and Cockroach, Structure of Parapodia,

General character, distribution and Evolutionary significance of Onychophora.

Mollusca: -Digestive System and Nervous System of *Pila*, Torsion and detorsion in Gastropods.

Echinodermata: -Water vascular system in Asteroidea,

#### **Unit IV: General Account of Invertebrates.**

**15 Hours**

Sexual reproduction in *Paramecium*. Evolution of Coelom and Metamerism, Filter feeding in Polychaetes, Trochophore larva, Photoreceptors in Arthropods, Metamorphosis in insects, Respiration in arthropods, Parasitism in Crustaceans. Larval form in Echinodermata,

#### **Suggested Readings:**

1. Barnes, R.D. (1982). Invertebrate Zoology, V Ed. Holt Saunders International Edition.
2. Boolotian & Stiles. 1981. College Zoology (10<sup>th</sup>Ed.)
3. Dorit, Walker & Barnes. 1991. Zoology (Saunders)
4. Marshall & Williams. 1972. Text book of Zoology. Vol. I (Parker & Haswell, 7<sup>th</sup>Ed.)
5. Nigam. 1997. Biology of Non-Chordates (S. Chand)
6. Villee, Walker & Baranes. 1979. General Zoology 5<sup>th</sup>Ed. Saunders
7. Hoar, 2005. General and Comparative Physiology (5<sup>th</sup>Ed. Cambridge)
8. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002).
9. Moore: An introduction to the invertebrates (2006, Cambridge).

Semester I

**LABORATORY COURSE BASED ON ZOO/BTCH-CC-102**

**ZOO/BTCH-CC-105**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Study of the salient features of the following Non-chordates:  
(*Amoeba*, *Entamoeba*, *Euglena*, *Giardia*, *Trypanosoma*, *Paramecium*, *Leucosolenia*, *Sycon*, *Euplectella*, *Spongilla*, *Euspongia*, *Obelia*, *Hydra*, *Aurelia*, *Tubipora*, *Medrepora*, *Milipora*, *Metridium*, *Planaria*, *Fasciola*, *Diphyllobothrium*, *Taenia solium*, *Dracunculus*, *Necator*, *Nereis*, *Pheretima*, *Hirudo*, *Peripatus*, *Palaeomon*, *Buthu*, *Leucifer*, *Limulus*, *Scorpion*, *Tick*, *Honey bee*, *Louse*, *Butterfly*, *beetle*, *Chiton*, *Unio*, *Sepia*, *Octopus*, *Starfish*, *Holothuria*).
2. Study of the following through permanent slides:
  - a) Larval forms of Echinodermata and *Fasciola hepatica*.
3. Slide preparation of the following:
  - a) Septal nephridia and Ovaries of Earthworm
  - b) Larval forms of Crustacea.
  - c) Mouthparts of Cockroach, House fly and Mosquito.
  - d) Trachea and Malpighian tubules of Cockroach.
4. Field survey for collection and identification of the following Non-Chordates:
  - a) Insects.
  - b) Earthworms.
  - c) Parasites of sheep and Goat.
5. Dissections of the following:
  - a) Earthworm- Digestive system, Reproductive system, Nervous system.
  - b) Cockroach- Digestive system, Reproductive system and Nervous system.
6. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester I**

### **FISH FARMING**

**ZOO-GE-102**  
**Credits: 02**

**Time: 30 Hours**  
**Max. Marks: (20+30)**

#### **Unit I: Scope and Importance**

**8 Hours**

Scope of Aquaculture, Economic value of fish: as food, food for cattle, fish oil, fish manure and guano, Fish Silage, Fish Glue and isinglass, Fish leather and soap. Role of fishes in Biological Control and harmful fishes, Cultivable species of fish.

#### **Unit II: Culture Techniques**

**7 Hours**

Extensive, Semi-intensive and Intensive Culture, Integrated fish culture with duck farming and Poultry farming, Composite fish culture. General account of Oyster culture, Pen and cage culture, Raft culture.

#### **Unit II: Fish Pond Management**

**7 Hours**

Types of pond for culture, Layout of fish farm, Prestocking management of ponds and Poststocking management of ponds, Resource of fish seed and their packing and transport methods.

#### **Unit IV: Fish Feed and Health**

**8 Hours**

Feed management, principle of feed preparation, types and different forms of feed, feed ingredient and feed formulation for different cultivable species. Nutritional diseases (Avitaminosis, Mineral deficiency, Starvation), Health management strategies: monitoring/inspection of fish diseases, Sanitation and disinfection, Vaccines.

#### **Suggested Readings**

1. Barnabe Gilbert, 1990. Aquaculture-Vol. II. Ellis Horwood: 1097 pp
2. Dilip Kumar, K. 1992. Fish culture in undrainable ponds. F.A.O. Tech. paper:325 P.240
3. Pillay, T.V.R. 1990. Aquaculture, Principles and Practices. Fishing News Books Ltd. p.575
4. Arumugam, N. 2008. Aquaculture, Saras publication p.480
5. Biswas, K.P. Prevention and control of fish and Prawn diseases. Sinderman, C. J. Principle diseases of marine fish and shell

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester II

### ANIMAL DIVERSITY (CHORDATES)

**ZOO/BTCH-CC-202**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: General Character and Classification of Chordates**

**15 Hours**

General characters and classification up to subclass level with distinctive and Adaptive features of Protochordates (Urochordates and Cephalochordates); Cyclostomata, Pisces, Amphibia, Reptilia, Aves and Mammalia. along with the suitable examples of each category.

#### **Unit II: Mode of Life in Protochordates and Anamniotes**

**15 Hours**

Protochordata: Digestive System and Circulatory system of *Herdmania*. Retrogressive Metamorphosis. Morphological and anatomical features of *Amphioxus*.

Pisces:-Digestive System, Respiratory System, Urinogenital system of *Scoliodon* Migration and Osmoregulation in fishes.

Amphibia: - Digestive System, Respiratory System, Urinogenital system of frog. Neoteny in amphibians.

#### **Unit III: General Organization of Reptiles**

**15 Hours**

Origin of Amniotes, affinities and general organization of *Sphenodon*; General organization of tortoise; Venomous and Non-venomous snakes of India, Poisonous apparatus and biting mechanism in snakes, Snake Venom, General organization and classification of Crocodilia, Extinct Reptiles(Dinosaurs).

#### **Unit IV: General Organization of Aves and Mammals**

**15 Hours**

Aves: Digestive System, Respiratory System, Urinogenital system of Pigeon. General characters of Archaeopteryx and its evolutionary significance General organization of flightless birds and their distribution, Flight adaptations in bird.

Mammals: - Aquatic mammals and adaptations, Volant mammals and adaptations.

#### **Suggested Readings:**

1. Dorit, Walker & Barnes: Zoology. Brooks Cole; 1 edition (February 15,1991)
2. Cambell and Reece: Biology (7th ed. 2005, Pearson)
3. Nigam: Biology of Chordates (1997, S. Chand)
4. Kotpal Series of Chordates (Rastogi Publications)
5. Parker & Haswell. 2005. Text book of Zoology Vol. II(Macmillan)
6. Tortora and Anagnostakos, 1986. Principles of Anatomy and Physiology (6<sup>th</sup>Ed.)
7. Schmidt, N. 2005. Animal Physiology (5<sup>th</sup>Ed.)
8. Hoar, 2005. General and comparative Physiology (7<sup>th</sup>Ed.) India print.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester II

### LABORATORY COURSE BASED ON ZOO/BTCH-CC-205

**ZOO/BTCH-CC-205**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Study of salient features of the following Museum Specimens:  
*Herdmania, Amphioxus, Lamprey, Scoliodon, Labeo, Cattla, Cyprinus, Trygon, Chimaera, Lung fish, Uraeotyphlus, Ambystoma, Alytes, Hyla, Salamander, Tortoise, Turtle, Cobra, Hydrophis, Viper, Agama, Crocodile, Sparrow, Bulbul, Crow, Parrot, Kiwi, Ducks. Platypus, Rat, Deer.*
2. Observations on the distinguishing characters of the following
  - a. Identification of Poisonous and Non-Poisonous snakes.
  - b. Distinguishing characters of Crocodile, Alligator and *Gavialis*.
3. Dissections:
  - a. Dissection of Fish to show Gills, Digestive system and Afferent and Efferent Cranial nerves.
  - b. Dissection of fowl/pigeon showing Digestive, Excretory and Reproductive systems.
  - c. Dissection of rat/mice/rabbit showing internal anatomy and Arterial and Venous systems.
4. Field survey for Photography and Identification of the local fauna;
  - a. Amphibian
  - b. Reptiles
  - c. Birds
5. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester II**

#### **WILDLIFE CONSERVATION AND MANAGEMENT**

**ZOO-GE-202**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Wildlife Importance and Conservation**

**15 Hours**

Definition of Wildlife, Importance of its study, Values of Wild life- positive and negative; Causes of depletion, Conservation of wild life (Insitu & Exsitu), Wildlife conservation ethics, World conservation strategies. Important National Parks, Wildlife sanctuaries and biosphere reserves of India with their characteristic wildlife, Protected areas of J&K State

#### **Unit II: Habitat Evaluation and Wildlife Conflicts**

**15 Hours**

Habitat analysis, evaluation and management of wild life: Physical parameters: Topography, Geology, Soil water; Biological parameters: food, cover, forage, browse and cover estimation; Impact of climate change on wildlife, Human-wildlife conflict and its management. Poaching and illegal trading.

#### **Unit III: Habitat Management**

**15 Hours**

Fire as management tool in grassland management. Habitat management techniques – control and regulation of grazing, Weed eradication, water hole management. Wetland; Characteristics, Method of wetland evaluation, physical, chemical and biological assessment of wetland. Management of invasive wetland species in India, Treaties for wetland conservation, RAMSAR and Bonn Convention.

#### **Unit IV: Wild life Protection Act and Projects**

**15 Hours**

Wildlife Protection Act (1972) and its detailed structure, Recent amendments in WPA 1972 and their role in Wildlife protection and Conservation. Wildlife conservation projects Project Tiger, Project Lion, Project Hangul, Role of organizations like; IUCN, CITES, TRAFFIC, WWF, BNHS in wildlife conservation.

#### **Suggested Readings**

1. Krausman, P.R. and Cain, W.J. 2013. Wildlife management and conservation, Contemporary Principles and Practices.
2. Frysell, J.M. and Sinclair, A.R.E. 2014. Wildlife Ecology, Conservation and Management.
3. Morrison, M. L. and Mathewson, H.A. 2015. Wildlife Habitat Conservation: Concepts, Challenges and Solutions (Wildlife Management and Conservation

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester II**

### **ENVIRONMENTAL SCIENCES**

**ZOO-AECC-201**  
**Credits: 02**

**Time: 30 Hours**  
**Max. Marks: (20+30)**

#### **Unit I: Concept of Environment**

**7 Hours**

Environment, Definition, Scope and importance, Concepts of ecology and ecosystem Food chain and food web Biogeochemical cycles (Hydrological cycle, Oxygen and Carbon) Concept of sustainable development

#### **Unit II: Environmentalism**

**7 Hours**

Environmental views: Anthropocentric and eco-centric view, Environmental activism and justice, Environmental feminism, Environmental movements (chipko, appiko), Green economy and green politics

#### **Unit III: Global Environmental Issues**

**8 Hours**

Environmental Pollutions. Definition, Causes, Consequences and control of Air, Water, Soil and Noise. Solid Wastes and management, Waste land reclamation, Global warming, Acid rain., Ozone layer depletion. Deforestation causes and consequences. Energy crisis. Biomagnification.

#### **Unit IV: Social Environmental Issues and Protection**

**8 Hours**

Environmental education, Public awareness. Role of mass media in environmental education. Role of an individual in conservation of natural resources and biodiversity, Environmental protection Act 1986, International conventions: Stockholm Declaration, Kyoto protocol, Montreal protocol and Earth summit, Challenges in environmental protection

#### **Suggested Readings**

1. Bram F. Noble 2005. Introduction to Environmental Impact Assessment: A Guide to Principles and Practice. Oxford University Press, London
2. John A. Wiens and Michael R. Moss 2005. Issues and Perspectives in Landscape Ecology. Cambridge University Press, London
3. Aparna Sawhney 2004. The New Face of Environmental Management in India. Ashgate Publishing Ltd., Sheffield

## Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

### Semester III

#### APPLIED ZOOLOGY

**ZOO/BTCH-CC-302**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Parasites & their Pathogenicity**

**15 Hours**

Introduction to Host Parasite Relationship, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis; Life cycle and pathogenicity and control of Medically and veterinary important parasites such as, *Echinococcus granulosus*, *Ascaris lumbricoides*, *Wuchereria bancrofti*, *Ancylostoma duodenale*, *Trichuris trichura* and *Enterobius vermicularis*

#### **Unit II: Economic Entomology and Vermiculture**

**15 Hours**

Beneficial Insects: Insect products (Honey, Silk and Lac). Insect pollinators; Insect as biological control agents (Predators and Parasitoids) of pests. Harmful Insects: Occurrence, life cycle and control of the pest attacking Apple (*Quadraspidiotus perniciosus*), Paddy (*Scirpophaga incertulas*) and Vegetable (*Pieris brassicae*) Vermiculture technique.

#### **Unit III: Aquaculture**

**15 Hours**

General account of Trout culture and carp culture; Trout culture in Kashmir, Induced breeding in fish. Pearl culture technique, Fish diseases and management (bacterial, Viral and Fungal). Prawn Culture- Freshwater and marine prawn culture, Aquatic weeds, their control and importance

#### **Unit IV: Farm animals**

Introduction; Indigenous and exotic breeds of Ruminants (Cows); Rearing, housing, feed and rationing; Commercial importance of dairy and poultry farming; Varietal improvement techniques; Diseases of Ruminants (Cows) and Poultry and their management.

#### **Suggested Readings:**

1. Prost, P.J. (1962). Apiculture. Oxford and IBH, New Delhi
2. Hafez, E.S.E. (1962). Reproduction in Farm Animals, Lea and Fabiger Publishers
3. Srivastava, C. B. L. (1999). Fishery Science and Indian Fisheries. Kitab Mahal Publ.
4. Sardar Singh, Beekeeping in India. Indian Council of Agricultural Research. New Delhi



# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester III

### LABORATORY COURSE BASED ON ZOO/BTCH-CC-302

**ZOO/BTCH-CC-305**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Study of placoid, cycloid and ctenoid scales through permanent slides.
2. Study of morphological characters of *Echinococcus*, *Ascaris*, *Wuchereria*, *Ancylostoma*, *Trichuris*, *Enterobius* with the help of permanent slides/specimens.
3. Mounting of placoid scales and Cycloid scales.
4. Disarticulated skeleton of Frog/Fowl.
5. Study of morphological characters of honeybee.
6. Study of morphological characters of *Bombyx mori*.
7. Collection of parasites from the liver of fish.
8. Collection of insect pollinators.
9. Collection and identification of Apple, Paddy and Cabbage pests
10. Visit to Sericulture rearing houses & Hatcheries of J & K & Identification of Diseases of Silkworm
11. Mounting of sting apparatus of Honey Bee.
12. Morphometry of fishes.
13. Visit to fish farm and Apiary.
14. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester III**

### **ORGANIC EVOLUTION**

**ZOO-GE-302**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Origin of Life and Evolutionary Theories**

**15 Hours**

Ancient and Medieval theories; Theory of special creation, Cosmozoic theory, theory of Abiogenesis, Theory of Biogenesis, Origin of universe, Characteristics of primitive earth, Chemosynthetic origin of life; Chemogeny, Biogeny and cognogeny. Evolutionary theories; Lamarckism, Darwinism, Neo-Darwinism, Neutral theory of evolution, Evidences of evolution.

#### **Unit II: Evolutionary Patterns, Fossils and Isolation**

**15 Hours**

Concept of organic evolution, Sequential and Divergent evolution, Anagenesis and Cladogenesis, Monophyletic, Polyphyletic and Paraphyletic evolution. Microevolution, Macroevolution and Megaevolution. Fossils, types and their significance, Reproductive Isolating mechanisms.

#### **Unit III: Population Genetics and Natural Selection**

**15 Hours**

Hardy-Weinberg equilibrium, Concept of gene pool, Factor effecting gene frequencies, Polymorphism in population (Balanced and Transient) Genetic drift, Founder effect and Bottleneck effect, Molecular clock concept, Natural selection, Types of Natural selection, Industrial melanism.

#### **Unit IV: Evolution of Man and Horse**

**15 Hours**

Evolutionary trends in man; Bipedal locomotion, Upright posture, Evidences from molecular biology in favour of Hominid evolution from apes, Common ancestors of Apes and Man in Oligocene and Miocene, Evolution of man in Pleistocene period, Monophyletic and Polyphyletic origin of man. Evolutionary changes in limbs skull in teethes of horse, Phylogeny of horse.

#### **Suggested Readings:**

1. Ridley, M. 2004. Evolution. III. Edition. Blackwell Publishing co.
2. Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D.B. and Patel, N. H. 2007 Evolution. Cold Spring, Harbour Laboratory Press
3. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
4. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
5. Genes in Population by Spiess. E (1989) 2nd Edition. Wiley-Liss, New York

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester III** **Skill Enhancement Course** **APICULTURE**

**ZOO-SEC-301**  
**Credits: 02**

**Time: 30 Hours**  
**Max. Marks: (20+30)**

#### **Unit 1: Introduction to Apiculture**

**8 Hours**

Importance and History, Biology and classification of honey bee species. Social organization in honey bees. Different species of honey bees used in honey production, Dance (Round and Wag tail dance), Structure of Pollen basket

#### **Unit II: Methods of Bee Keeping**

**7 Hours**

Bee hive structure and temperature regulation. Methods of bee keeping- Indigenous methods of extraction of honey, Modern methods of apiculture, Bee flora and qualities of good bee flora, selection of bees for Apiculture.

#### **Unit III: Bee Products, Enemies and Disease**

**7 Hours**

Honey (mechanism, Chemical Composition and Medicinal value), Economic importance of bee wax, Bee venom (chemical composition and its pathology), Honey bee disease and their control, Bee enemies and their control.

#### **Unit IV: Principal of Bee Management**

**8 Hours**

Spring Management (swarming and control), Summer Management (Extraction of honey), Monsoon and Autumn Management, Winter Management, Miscellaneous management (Dividing, Uniting & shifting bee colonies, Robbing and absconding, supplementary feeding and Queen management.

#### **Suggested Readings:**

1. Prost, P.J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Sardar Singh, Beekeeping in India. ICAR, New Delhi.
3. Dhyan Singh Bisht, Apiculture. ICAR Publication.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester IV**

#### **ANIMAL ECOLOGY**

**ZOO/BTCH-CC-402**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Introduction to Ecology**

**15 Hours**

Relevance of studying ecology, History of ecology, Autecology and synecology, levels of organization, Laws of limiting factors: Liebig's law; Law of tolerance; Factor compensation; Light as physical factors; Temperature as physical factor; Concept of temperature regulation in homeotherms and poikilotherms

#### **Unit II: Population and Biodiversity**

**15 Hours**

Population characteristics, Population Size and density, Age structure, Natality, Mortality, life tables, Survivorship curves, Population dynamics and dispersion, Exponential and Logistic growth, equation and pattern. r and k strategies. Population regulation-density dependent and density independent factors. Gause's Principle, Lotka- Volterra Equation, Biodiversity, types, significance and conservation.

#### **Unit III: Community Ecology and Succession**

**15 Hours**

Community characteristics, Classification of Communities, composition of community, Dominance, diversity, species richness, abundance, Horizontal and Vertical stratification, Habitat and Niche, Ecotone and Edge effect, Ecotypes, Ecological succession Causes, types and process of succession. Theories pertaining to climax community

#### **Unit IV: Ecosystem Structure and Function**

**15 Hours**

Kinds of Ecosystem, Components of Ecosystem, Productivity of Ecosystem, Food chain, detritus and grazing food chains, Linear and Y-shaped food chains. Food web, Energy flow. Ecological pyramids and ecological efficiencies. Biogeochemical Cycles (H<sub>2</sub>O & N<sub>2</sub>)

#### **Suggested Readings:**

1. Colinvaux, P.A. (1993). Ecology. II Edn. Wiley, John and Sons.Inc.
2. Krebs, C. J. (2001). Ecology. VI edn. Benjamin Cummings.
3. Odum, E.P. (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith, Ecology and field biology Harper and Row publisher.
5. Rucklefs, R.E. (2000). Ecology. V. edn. Chiron Press

**Semester IV**

**LABORATORY COURSE BASED ON ZOO/BTCH-CC-402**

**ZOO/BTCH-CC-405**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Collection and identification of animal Biodiversity of selected ecosystem
2. Study of life tables and plotting of survivorship curves of different types from the hypothetical/ real data provided.
3. Determination of population density in a natural/hypothetical community by Quadrant method and calculation of Shannon-Weiner diversity index for the same community.
4. Study of aquatic ecosystem: fauna and flora.
5. Physico-chemical analysis of lotic water (Measurement of temperature, turbidity/ penetration of light, determination of pH, DO, FCO<sub>2</sub>, Carbonates and Bicarbonates).
6. Physico-chemical analysis of soil pH, soil moisture soil, temperature, humidity estimation, soil organic matter.
7. Collection, preservation and estimation of Zooplankton.
8. Estimation of LC<sub>50</sub> or LD<sub>50</sub> of an organo phosphorous pesticide
9. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

**Semester IV**

**COMPARATIVE ANATOMY OF VERTEBRATES**

**ZOO-GE-402**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

**Unit I: Integumentary and Skeletal Systems**

**15 Hours**

Integumentary system and function of integument, Derivatives of the Integument, Epidermal derivatives: glands; Epidermal Scales, Horns, Feathers & Hair. Skull embryonic components and Morphogenesis, Jaw suspensions in Vertebrates, Types of Vertebrae in Vertebrates.

**Unit II: Digestive and Respiratory systems**

**15 Hours**

Digestive system: - Alimentary canal and associated glands in Vertebrates. Structure of stomach in ruminants, Respiratory system: - skin, gills (external and internal gills) lungs and Air sacs; Accessory respiratory organs of Vertebrates, Swim or air bladder.

**Unit III: Circulatory and Urinogenital systems**

**15 Hours**

Circulatory system: - General plan of circulation, evolution of heart and Modification of aortic arches. Blood, Function of blood, lymphatic system; Urinogenital system: - Vertebrate kidney: Pronephros, Mesonephros and Metanephros. Gonads and their ducts in Elasmobranchs, Amphibia, Reptilia, Aves & Mammals.

**Unit IV: Nervous system & Sense organs**

**15 Hours**

Nervous system: - Central Nervous system in Vertebrates (Elasmobranchs, Teleosts, Amphibia Reptilia, Aves and Mammalia Sense organs: - Classification of receptors: Brief account of visual receptors in Elasmobranchs, Amphibia, Reptilia, Aves and Mammalia. Cutaneous receptors and Chemoreceptors.

**Suggested Readings:**

1. Kardong, K. V. 2005. Vertebrate's Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr, R.K. 2000. Comparative Anatomy of the Vertebrates. IX Edition the McGraw-Hill Company.
3. Weichert, C.K. and William Presch. 1970. Elements of Chordate Anatomy. Tata McGrawHills
4. Hilderbrand, M. and Gaslow, G.E. Analysis of Vertebrate Structure. John Wiley and sons

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester IV**

### **Open Generic Elective**

### **PUBLIC HEALTH AND HYGIENE**

**ZOO-OGE-401**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

#### **Unit I: Introduction**

**7 Hours**

Scope of Public health and Hygiene- nutrition and health- classification of food- Nutritional deficiencies. Vitamin deficiencies.

#### **Unit II: Environment & Health Hazards**

**8 Hours**

Environment and health hazards- Environmental degradation- Pollution and associated health hazards. Impact of non-biodegradable material.

#### **Unit III: Communicable diseases**

**7 Hours**

Communicable diseases and their control measures such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS.

#### **Unit IV: Non-Communicable diseases**

**8 Hours**

Non- Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill health.

#### **Suggested Readings:**

1. Sunder Lal Adarsh, 2009. Text book of Community medicine: Preventive and Social Medicine. CBS Publishers and Distributors.
2. Mahajan and Gupta. 2013. Text book of Preventive and Social Medicine Jaypee brothers (Publisher).

## Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

### Semester V

### GENETICS

**ZOO-CC-501**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Mendelian Genetics**

**15 Hours**

Mendel's selection of experimental plants, Phenomenon of dominance, Mechanism of dominance, Variation in dominance (Incomplete dominance and Codominance) Law of Segregation, law of independent assortment, Mendel's monohybrid and dihybrid cross, Back cross and test cross. lethal alleles, Epistasis; dominant and recessive epistasis, Complementary and supplementary genes, Pleiotropy.

#### **Unit II: Linkage and Sex linked Inheritance**

**15 Hours**

Linkage, Chromosomal theory of Heredity, complete and incomplete linkage, linkage groups and significance of linkage, Crossing Over Mitotic and Meiotic Crossing over, Cytological basis of crossing over, molecular mechanism of crossing over; Two factors and three factor crosses; tetrad analysis, Interference and Coincidence; Somatic cell hybridization, Sex linked inheritance in human beings, Sex influenced and Sex limited genes.

#### **Unit III: Multiple Alleles and Cytoplasmic Inheritance**

**15 Hours**

Multiple alleles, Coat Color in Rabbit, Blood groups in humans and Bombay phenotype, Rh factor and Eye Color in *Drosophila*, Evidences for Cytoplasmic inheritance, Maternal inheritance in *Limnaea*, Extra-Nuclear inheritance in *Paramecium* (Kappa particles), Chloroplast inheritance in four o'clock plant, Sigma virus in *Drosophila*,

#### **Unit IV: Gene Mutation and Genetic Disorders**

**15 Hours**

Mutations; kinds of mutations, Point Mutations, Multiple mutations, Spontaneous mutations, Induced mutations, Radiations and temperature as mutagen, Chemical mutagens, Detection of mutations; Polygenic inheritance and Transgressive variations. Mitochondrial mutation, Genetic disorders- Huntington disease, Duchene muscular dystrophy, Hemophilia, Thalassemia, and Cystic fibrosis.

#### **Suggested Readings:**

1. Gardner, E. J., Simmons, M. J., Snustad, D.P. (2008). Principles of Genetics. VIII. Ed. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V. Ed. John Wiley and sons
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of genetics. X Ed. Benjamin Cummings.
4. Russell, P.J. (2009). Genetics a molecular approach. III Ed. Benjamin Cummings.
5. Griffith, A.J.F., Wessler, S. R., Lewontin, R.C. and Carroll, S.B. Introduction to Gen



# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester-V

### PARASITOLOGY AND ENTOMOLOGY

**ZOO-CC-502**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Parasitic Associations**

**15 Hours**

Parasitism, and types of parasite, Types of Vectors and Host, Evolution of parasitism; Distribution of parasitism in animal kingdom. Concept of Susceptibility, Gastro-intestinal tract as a habitat of Protozoan and helminths parasites, Reticulo-endothelial system as a habitat of Protozoan parasite of man, Parasitic adaptations in helminths

#### **Unit II: Life Cycle and Pathogenicity of Parasites**

**15 Hours**

Morphology, life cycle, pathogenicity, prevention and control of *Giardia intestinalis*, *Leishmania donovani*, *Balantidium coli*, *Trichomonas vaginalis*, *Schistosoma haematobium*, *Diplozoon kashmiriensis* and *Trichinella spiralis*.

#### **Unit III: Classification and Morphology of Insects**

**15 Hours**

Classification of insects- Important orders of Apterygota: (Thysanura, Collembola), Exopterygota: (Odonata, Isoptera, Orthoptera, Dictyoptera, Dermaptera, Mallophaga, Hemiptera), and Endopterygota: (Lepidoptera, Diptera, Coleoptera, Hymenoptera). Sound producing organs in insects with reference to Stridulation in *Gryllus*, *Grasshoppers* and Light producing organs and mechanism of light production in firefly.

#### **Unit IV: Endocrine Glands and Ecto-hormones in Insects**

**15 Hours**

Endocrine glands in insects; Neurosecretory cell, Corpora allata, Corpora Cardiaca and Prothoracic gland; Chemical defence in insects; Adaptive radiation in insects (Mimicry & Adaptive colouration), Types of Pheromones and Allomones in insect and their significance.

#### **Suggested Readings:**

1. Arora, D.R. and Arora, B. (2001). Medical Parasitology II Ed. CB Publ.
2. Noble. E.R. and Noble, G.A. 1982. Parasitology: The biology of animal Parasites V Ed. Lea & Febiger.
3. Chatterjee, K.D. 2009. Parasitology: Parasitology and Helminthology XIII Ed., CBS pulb. & Distributor.
4. Gillot, J. E. Entomology.
5. Smith, J.D. Introduction to parasitology

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester V

### LABORATORY COURSE BASED ON ZOO-CC-501

**ZOO-CC-504**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Study structure of Giant chromosomes from permanent slides.
2. Chromosome preparation from the root tip cells of *Allium cepa*.
3. Chromosome preparation: Meiotic stages of Grasshopper testis.
4. Idiogram preparation and determination of karyotype asymmetry in *Homo sapiens*.
5. Identification of ABO Blood groups
6. Extraction of DNA from tissues
7. Extraction and isolation of RNA from tissues
8. Estimation of RNA, DNA in tissues
9. Identification of various mutants of *Drosophila*.
10. Pedigree analysis of Haemophilia,
11. Preparation of Polytene chromosomes from Chironomous/*Drosophila* larva.
12. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

## Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

### Semester V

#### **LABORATORY COURSE BASED ON ZOO-CC-502**

**ZOO-CC-505**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Study of different morphological characters of Grasshopper, Cockroach, Honeybee, Dragonfly and Damselfly, Butterfly and moth, Beetle, Housefly, Wasp.
2. Collection and Identification of common fish parasites.
3. Collection and Identification of parasites of poultry.
4. Study of morphological characters of *Leishmania donovani*, *Balantidium coli*, *Giardia intestinalis*, *Trichomonas vaginalis*, *Trichinella spiralis*, *Diplozoon kashmiriensis*, and with the help of permanent slides.
5. Insects collection, identification and preparation of insectarium.
6. Visit to Sericulture Research Institute
7. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester V

### AGRO-CHEMICALS AND PEST MANAGEMENT

**ZOO-GE-502**  
**Credits: 04**

**Time: 60 Hours**  
**Max. Marks: (40+60)**

#### **Unit I: Introduction of Pest**

**15 Hours**

Definition, Origin and Categories of pest, assessment of pest population Pest resurgence, Secondary pest outbreak and causes of pest outbreak, Types crop losses caused by pest, Concept of injury level (General Equilibrium Position, Economic Injury Level and Economic Threshold Level.

#### **Unit II: Chemical Insecticides**

**15 Hours**

Chemical insecticides: Classification of insecticides, Factors influencing effectiveness of insecticides, Organo- chlorine insecticides (DDT and its analogues)- their mode of action and hazards, Carbamates, their mode of action, Organophosphates insecticides-their brief classification mode of action and hazards. Environmental impact of insecticides.

#### **Unit III: Biological and Microbial Control**

**15 Hours**

Biological control: definition principles and successful examples of pest control through biological control agents (predators and Parasitoids). Microbial control, advantages and disadvantages, Role of Viruses, Bacteria (*Bacillus thuringiensis*, *Bacillus sphericus* & *Bacillus popilliae*), and fungi in Pest control.

#### **Unit IV: Integrated Pest management**

**15 Hours**

Integrated Pest management- Concept and strategies, Methods and characteristics of Cultural control, Physical and Mechanical control, Genetic manipulation of pest population (Sterile insect release & Hybrid sterility). Role of insect hormonal in pest control.

#### **Suggested Readings:**

1. Pradhan, S. (1969). Insect pests of crops. National Book Trust, India Book House.
2. Atwal, A. S. (1993). Agricultural Pest of India and South East Asia. Kalyani Publ. New Delhi.
3. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall Publication.
4. Robert, F. Norris, Edward P. Caswell-Chen and Marcos Kogan, Concepts of Integrated Pest management, Prentice Hall of India.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester V

### SERICULTURE

**ZOO-DSE-502**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

#### **Unit I: Introduction to Sericulture**

**8 Hours**

Definition, Origin and history of sericulture; Silk route. Role of sericulture in rural development. Types of Silk. Mulberry and Non-mulberry silk worms in India their distribution and food plants. Sericulture practices in India: Concept of traditional and nontraditional practices.

#### **Unit II: Biology of Mulberry Silkworm**

**7 Hours**

Moriculture: Biology of *Bombyx mori*; Morphology of egg, larva, pupa and adult; Popular varieties /races of *Bombyx mori* of India. Concept of Voltinism and Moulting. Physical and Chemical properties of Silk. Factors affecting spinning behavior and grading of Cocoons in *Bombyx mori*.

#### **Unit III: Chowki Rearing**

**7 Hours**

Chowki rearing: Concept, Objective and Principles. Incubation methods, black boxing-significance-role of environmental factors in incubation. Brushing-methods their advantages and disadvantages. Methods of Chowki rearing- optimum conditions for Chowki rearing.

#### **Unit IV. Silkworm Rearing Houses**

**8 Hours**

Requirements for an Ideal silkworm rearing house with reference to *Bombyx mori* in J & K. Rearing appliances/equipments. Disinfection of rearing houses its concept and objective-classification, formulation and dosage calculation. (Visit to Sericulture Research institute.)

#### **Suggested Readings:**

1. Venkatanarasiah, P. 2013.Sericulture.
2. Rahman, M.M. & Sultana, N. 2013.Sericulture.
3. Hisao Aruga. 1994. Principles of Sericulture, Oxford IBH
4. Ullal, S.R. and M N Narasimhanna. 1987.Handbook of practical Sericulture, CSB, Bangalore
5. Krishnaswamy, S. 1986. New Technology of Silkworm rearing. Reprinted, CSB, Bangalore
6. Ganga, G. and J. Sulochna Shetty, 1991. An Introduction to Sericulture. Oxford IBH

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester VI**

### **REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY**

**ZOO-CC-601**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Asexual Reproduction and Regeneration**

**15 Hours**

Asexual reproduction and its evolutionary significance in Metazoans, Mode of Asexual reproduction, Fragmentation, Fission, Strobilation, Budding, Gemmule and Statoblast formation, Parthenogenesis, types and Significance, Arrhenotoky, Thelytoky, Regeneration, Types, Modes of regeneration in invertebrates, Mechanism of Limb regeneration in Amphibians

#### **Unit II: Reproductive Organs and their Functions**

**15 Hours**

Structure of testis and ovary in human. Reproductive glands in male and female, Mechanism and site of Spermatogenesis, Sperm Longevity, Factors controlling spermatogenesis, Oogenesis process, Mechanism of Vitellogenesis, Polarity and Symmetry of egg, Causes of meiotic arrest and significance of unequal cytokinesis during oogenesis, Gonadal Hormones, Regulation of gonadotrophin secretion in male and female.

#### **Unit III: Reproductive Cycles and Early Events**

**15 Hours**

Reproductive cycles; Estrous cycle, Vaginal and Uterine changes during Estrous cycle.; Menstrual Cycle and regulation of reproductive cycle. Mechanism of Ovulation and its regulation, Follicular atresia, Corpus luteum formation and regression; Fertilization; Changes in gametes, Implantation of embryo in humans.

#### **Unit IV: Embryonic Development**

**15 Hours**

Types of eggs, Cleavage, planes and pattern, Morphogenetic movements during Gastrulation, Fate map of frog. Metamorphosis: changes, hormonal regulation in amphibian, Extra embryonic membranes in birds; Fate map of Mammalian blastula, Placenta, structure, types and functions. Embryonic Induction, Lens and Neural induction in Vertebrates.

#### **Suggested Readings**

1. Gilbert, S.F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts(USA)
2. Balinsky, B.I. and Fabian, B.C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
3. Kalthoff (2008). Analysis of Biological Development, II Edition. McGraw-Hill Pub.
4. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford Univ. Press.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester VI**

### **ANIMAL PHYSIOLOGY**

**ZOO-CC-602**

**Credit: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Physiology of Nutrition and Respiration**

**15 Hours**

Digestion and absorption of macronutrients, digestive enzymes and their role, Gastrointestinal hormones and regulation, Cellulose digestion in Ruminant, Stimulation of hunger and thirst, Pulmonary ventilation, Respiratory centres: organization and function, Surfactant, Gaseous exchange through respiratory membrane and tissues, Mechanism of O<sub>2</sub> and CO<sub>2</sub> transport, Diving adaptations in Vertebrates; Altitudinal adaptations to low oxygen pressure (mountain sickness)

#### **Unit II: Physiology of Circulation and Excretion**

**15 Hours**

Blood, Haemopoiesis, Haemostasis, Haemoglobin: Structure and function, Blood Coagulation, Anti-Coagulants, Blood buffers, Lymph: composition and functions, Origin and conduction of Cardiac impulse, Cardiac cycle, Excretion, Urine formation, Glomerular filtration, Tubular reabsorption and secretion, Counter current mechanism, Juxtaglomerular apparatus, Hormonal regulation, Acid-base balance and homeostasis

#### **Unit III: Physiology of Muscles**

**15 Hours**

Comparative molecular structure and function of skeletal, smooth and cardiac muscles, Ultrastructure of skeletal muscle fibers, Muscle proteins, Sequence of events in contraction and relaxation of skeletal muscle, Sliding filament theory of muscle contraction, Energetics of muscle contraction, Muscle twitch, summation, tetanus and fatigue, Isotonic and isometric contraction,

#### **Unit IV: Physiology of Nerves**

**15 Hours**

Nervous system, Axonal transmission, Motor neuron and other types of neurons, Genesis of membrane potential and action potential, Sodium-potassium pump, Synaptic transmission, Types of synapses and synaptic knobs, Excitatory and inhibitory post-synaptic potential, Chemical transmission, neurotransmitters (acetylcholine, or catecholamines, serotonin and GABA), Autonomic nervous system (Sympathetic and parasympathetic)

#### **Suggested Readings**

1. Guyton, A.G. 1986. Text book of Medical Physiology, 7<sup>th</sup>Edn
2. West, J.B. 1985. Best and Taylor's Physiological basis of Medical practice (Williams& Wilkins).
3. Hoar, W.S. 1983. General and comparative animal physiology, 3rd edn. (prentice Hall)
4. Eckert, R. and D. Randall. 1983. Animal Physiology. 2nd edn. W.H. Freeman &Co.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester VI**

### **LABORATORY COURSE BASED ON ZOO-CC-601**

**ZOO-CC-604**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Study of spermatogenesis and identification of its various stages with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
2. Study of Reproductive organ in fishes/rats
3. Structure of egg in birds.
4. Demonstration of oogenesis in earthworm/ fish/ rat ovary with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
5. Histology of male and female reproductive organs and accessory reproductive glands with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
6. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula.
7. Study of different sections of placenta (photomicrograph/ slides).
8. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean



# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester VI**

### **LABORATORY COURSE BASED ON ZOO-CC-602**

**ZOO-CC-605**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Adrenalin and insulin induced changes in blood glucose levels in rat/mice.
2. Preparation of Slide of Haemin crystal.
3. Finding of BT and CT of blood.
4. Counting of mammalian RBCs and WBCs.
5. Determination of Sedimentation rate of Erythrocytes.
6. Estimation of Hemoglobin
7. Study the digestion of starch by salivary amylase at different pH and Temperature.
8. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

**Semester VI**

**POULTRY AND DAIRY FARMING**

**ZOO-GE-602**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

**Unit I: Classification and Importance of Fowl**

**15 Hours**

External morphology of Fowl varieties such as Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn. 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 II: Diseases and their Management**

**15 Hours**

Poultry diseases- Viral, Bacterial, Fungal and Protozoan- their prevention and control. Management of egg layers and Broilers in large scale farms. Poultry feed. Importance and adverse effects on excessive use of Antibiotics and Growth promoters. Progressive plans to promote poultry as a self-employment venture.

**Unit III: Dairy Development and Milk Marketing**

**15 Hours**

Livestock in India- related to dairy farming; Common animal husbandry terms; Dairy development in India, NDDB, NDRI, Dairy Cooperatives. Important cows and buffalo breeds. Composition of milk; factors affecting the quality of milk; milk collection; Pasteurization; grading and packaging; transportation and distribution.

**Unit IV: Diseases and Management in Cattle**

**15 Hours**

Diseases of cattle- Foot and mouth diseases, Anthrax, Haemorrhagic septicaemia, Babesiosis, Mastitis & Milk fever. General management practices of Dairy farming- (Grooming, Castration, Dehorning, Trimming, Shoeing), Calf management and management of pregnant and lactating Cow and Buffaloes. Importance of grassland and fodder in dairy farming. Livestock waste utilization and recycling.

;

**Suggested Readings:**

1. Thomas, C. K. and Sastry, N. S. R. 1991. Dairy Bovine Production.
2. Watson, J.A.S. and Mills, W.J. 2005. Farm animals and their management.
3. Reddy, D.V. Fodder production and grassland management for Veterinarians.
4. Banerjee, G.C. A text book of Animal Husbandry.
5. Jagdish Prasad, Animal Husbandry & dairy science.
6. Panda, A. K. Rural Poultry production.
7. Ibne Ali & Singh, D. K. Handbook of poultry husbandry.
8. Anand, B. Handbook of poultry disease diagnosis & treatment.
9. Viyas, M. K. Glimpse of Indian Poultry Industry.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester VI**

### **BIostatISTICS**

**ZOO-DSE-601**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: 50**

#### **Unit I: Statistical Data**

**7 Hours**

Biostatistics: Definition and Application; Data and its collection; Classification of data: Primary & Secondary data; Limitations of statistics; Variables: Discrete and continuous variable, Samples- random samples, Frequency distribution: relative frequency distribution & cumulative frequency distribution, frequency table.

#### **Unit II: Graphical representation of Data**

**7 Hours**

Graphical representation of statistical data, advantages & disadvantages of graphical representation; Types of Graphs-Line chart, Bar chart, Pie chart, Pictogram, Histogram; Measures of central tendency: arithmetic mean, median and mode;

#### **Unit III. Probability and Testing**

**8 Hours**

Probability: classical & axiomatic definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions; Sampling: sampling theory, sampling and non-sampling error, standard error; confidence interval and Testing of hypothesis: procedure of testing hypothesis, null & alternative hypothesis, T-test, chi-square test for goodness of fit Problems on test of significance.

#### **Unit IV. Correlation and Regression**

**8 Hours**

Correlation analysis: Correlation and coefficient of Correlation, Calculation and properties of co-efficient of Correlation; Spearman rank correlation coefficient; Regression analysis: Regression and regression coefficient, properties of regression coefficients, linear regression: analysis and interpretation; analysis of variance (ANOVA).

#### **Suggested Reading:**

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.
5. Arora P.N. and Malhan, P.K., (2012) Biostatistics, Himalaya Publishing House
6. K. Sharma (2008) A. K. Sharma Vol I & II Discovery Publishing House Pvt. Ltd

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VII

### POPULATION ECOLOGY AND LIMNOLOGY

**ZOO-CC-701**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Population Ecology**

**15 Hours**

Population characteristics, Life table: types and importance; Concept of Trade-offs in life history of organism: regulation of reproductive effort by trade-offs between fecundity and survival, Trade-offs between number and size of offspring; Iteroparous and Semelparous reproduction strategies; Role of intraspecific competition in population regulation; Role of Predation in population regulation; Concept of Meta-population; Meta-population dynamics: Colonization and Extinction; Rescue effect; Sources and sink concept in meta-population.

#### **Unit II: Ecosystem Energetics and Landscape dynamics**

**15 Hours**

Energy flow: Laws of thermodynamics; Primary production and its regulation in terrestrial and aquatic ecosystem; Secondary productivity: concept and regulation; Energy flow through trophic levels: food chain; Landscape ecology: definition and relation to level of organization concept; biodiversity at the community and landscape level; Neutral theory; Landscape connectivity: importance in landscape dynamics.

#### **Unit III: Inland water and its Physico-chemical Properties**

**15 Hours**

Limnology: Definition, history and Scope; Types of Inland water: Lentic and Lotic; Lakes: types and thermal classification; River: Classification and features; Light as a physical factor: penetration of Light and its relation with aquatic organisms; Temperature as a factor: Impact on aquatic living organism, thermal stratification in oligotrophic and eutrophic lakes; Nutrients: Nitrogen, its forms and role in aquatic ecosystem; Phosphorus, its forms and role in aquatic ecosystem; Dissolved gases: dissolved oxygen (Orthograde and Clinograde concepts) and carbon dioxide.

#### **Unit IV: Biological Properties of Inland water**

**15 Hours**

Plankton: Types; Classification of plankton; Zooplankton: types of zooplankton, Seasonal cycles, top down control of zooplankton, Diel migration and Cyclomorphosis; Phytoplankton: types of phytoplankton, seasonal cycle in phytoplankton, role of chlorophyll-a and nutrient ratio (N:P) in phytoplankton biomass estimation; Benthic plants: types and importance; Zoobenthos: types, factors affecting their distribution in lakes and significance.

#### **Suggested Readings:**

1. Phillipson, J. 1966. Ecological Energetic, Edward Arnold Ltd. London.
2. Odum, E.P. 1971. Fundamentals of Ecology, W.B. Saunders, USA.
3. Kormondy, E.T. 1971. Concept of Ecology. Prentice Hall of India, New Delhi.
4. Cole, A.A. 1974. Text book of Limnology. The G.V. Mosby Company Saint Louis.
5. Arvind Kumar. 2005. Fundamentals of Limnology.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VII

### CYTOGENETICS

**ZOO-CC- 702**

**Credit: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Structure and Organization of Chromosome**

**15 Hours**

Chromosome structure in pro-and eukaryotes, nucleosome model, telomere structure. Specialized chromosome types, Lampbrush and Polytene chromosomes. Accessory chromosomes, occurrence, behaviour, transmission and origin. Ring chromosomes Formation, Detection, Behaviour at meiosis. Karyotype symmetry; chromosome numbers; symbols & terminologies, Chromosome Banding Techniques its Significance and applications.

#### **Unit II: Numerical Variations in Chromosomes**

**15 Hours**

Polyploidy-induction and types. Autopolyploids meiotic behaviour, Segregation. Effect of autopolyploidy. Allopolyploids – classification, meiotic behaviour, Role of allopolyploidy in evolution of wheat, potato, tobacco and cotton. Aneuploidy: types of aneuploids; induction of trisomics, monosomics and nullisomes-their role in chromosome mapping. Numerical disorders: Patau's syndrome, Edward's syndrome, Down's syndrome, Turner's syndrome and Klinefelter's syndrome.

#### **Unit III: Structural Variations in Chromosomes**

**15 Hours**

Types of structural chromosome alterations- deletion, duplication, meiotic behaviour and utility. Identification, meiotic behaviour and induction of inversions. Identification, meiotic behaviour and induction of translocations. Significance of structure alterations of chromosomes in evolution. Cri du Chat, Williams syndrome, Fragile X syndrome, Prader-Willi syndrome and Burkitt's lymphoma

#### **Unit IV: Molecular Cytogenetic**

**15 Hours**

Chromosomal DNA content and C-value paradox. Gene amplification; mechanism and significance, Genome evolution. Repetitive DNA sequences, techniques for detecting repetitive DNA. FISH and GISH techniques: principles and applications, concept of chromosome painting. Flow Cytometry. Alien addition and substitution- Their role in gene transfer. Human genome project.

#### **Suggested Readings:**

1. Burnham, C.R. (1962): Discussions in Cytogenetics Burgess Publ. Co. Minneapolis.
2. Garber, G.B. (1972): Cytogenetics. McGraw Hill. Pub. Co. Ltd.
3. Hexter, W. and Yost: The science of Genetics. Prentice Hall Inc.
4. Srb. A.M. Owen, R.D. and Edgar, R.S. General genetics, W.H. Freeman and Co., San Fransisco.
5. Sinnett, E.W., Dunn, L.C. and Debzhanski, Th (1958): Principles of genetics. Kugakusha. Co. Inc. Ltd. Japan.
6. P.K. Gupta, Rastogi Publ. Merrut. 1994. Cytogenetics, Genetics and Evolution

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester VII**

### **INFECTIOUS DISEASES**

**ZOO-CC-703**

**Credit: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

#### **Unit I: Introduction to Infectious Diseases**

**7 Hours**

Basic concepts in patho-physiology of infectious diseases, Outline of physiological mechanisms leading to diseased state, Infectious disease transmission, Infection and immunity, Acute and chronic Infections, Major infectious diseases of humans.

#### **Unit II: Bacterial Diseases**

**8 Hours**

Pathogenesis, mechanisms of pathogenesis; transmission, epidemiology, public health implications, diagnosis, prophylaxis and treatment of major human infections (Tuberculosis, Cholera, Typhoid).

#### **Unit III: Viral Diseases**

**7 Hours**

Pathogenesis, mechanisms of pathogenesis; transmission, life cycle, epidemiology, public health implications, diagnosis, prophylaxis and anti-retroviral therapy of Human immunodeficiency virus (HIV/AIDS); Sexually transmitted diseases.

#### **Unit IV: Fungal and Protozoan Diseases**

**8 Hours**

Pathogenesis, mechanisms of pathogenesis; transmission, life cycle, epidemiology, public health implications, diagnosis, prophylaxis and treatment of major Fungal human pathogens: (Dermatophytes, Candida, Aspergillus); Protozoal human pathogens (Plasmodia and Trypanosoma).

#### **Suggested Readings:**

1. Animal Parasitology by J. D. Smyth.
2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts.
3. General parasitology by Thomas C. Cheng.
4. Georg's parasitology for Veterinarians by D. D. Bowman
5. Parasitology (Protozoology & Helminthology) by K. D. Chatterjee.
6. Parasitology by Elmer R. Nobel and Glenn A. Noble.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VII

### LABORATORYCOURSEBASED ON ZOO-CC-701, ZOO-CC-702 & ZOO-CC-703

**ZOO-CC-704**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

1. Determination of physico-chemical characteristics of Lentic water bodies.
2. Determination of physico-chemical characteristics of Lotic water bodies.
3. Qualitative and quantitative estimation of phytoplankton from freshwater aquatic system.
4. Qualitative and quantitative estimation of zooplankton from freshwater aquatic system.
5. Collection and identification of macrophytes from local water bodies (lakes and pond streams and canals)
6. Collection and identification of macrobenthos from local water bodies (lakes and ponds, streams and canals)
7. Estimation of primary productivity in freshwater bodies.
8. Estimation of biomass of Macrophytes.
9. Idiogram preparation and determination of karyotype asymmetry in *Homo sapiens*.
10. Structure of salivary gland chromosomes of *Drosophila*/Chironomus larva.
11. Any other practical found feasible by the teacher approved by Head/ Coordinator & Dean.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VII

### FISH BIOLOGY

**ZOO-DSE-701**

**Credits: 04**

**Time: 60 Hours**

**Max Marks: (40+60)**

#### **Unit I: Fish Structure and Adaptations:**

**15 Hours**

Methods of Locomotion in Fishes, Types and Mode of Locomotion, Role of Fins in Locomotion, Structure and origin of fins, Modification and Functions of Fins, Types of Caudal Fin, Lateral Line System, Morphological and anatomical adaptations in Hill streams fishes, Deep sea fishes, Arctic and Antarctic fishes.

#### **Unit II: Skin Derivatives and Special Features**

**15 Hours**

Skin derivatives; Scales, type and function of Scales in fishes, Coloration, Chromatophores, Pigments and Biological Significance of Coloration in Fishes; Weberian Ossicle, Structure, Origin, Working and Function; Structure and function of Electric organs in Fishes, Bioluminescence in fishes and its significance.

#### **Unit III: Fish Physiology**

**15 Hours**

Alimentary Canal and its modifications, Food, feeding habits and Feeding Adaptations, Respiratory Organs; Structure and Functions of Gills, Mechanism of Gill Respiration, Accessory Respiratory Organs in Fishes, Structure of Heart; Afferent and Efferent Branchial Vessels, Composition of Blood, Polymorphism in Haemoglobin; Structure of Kidney, Types I, II, III and V. Osmoregulation in Freshwater, Brackish Water and Marine Water Fishes.

#### **Unit IV: Fish Reproduction and Growth**

**15 Hours**

Reproductive Organs and Accessory Sex Organs, Maturation and Spawning, Seasonal changes and Gonado-Somatic Index (GSI), Hormonal Regulation of Fish Reproduction, Types of Eggs, Nest Building and Parental Care, Hybridization, Gynogenesis and Androgenesis. Growth and Age Determination in fishes through hard parts (Scales, Otoliths and Operculum).

#### **Suggested Readings:**

1. Textbook of Fish Biology & Indian Fisheries Rahul P Parihar
2. A Text Book of Fish Biology and Fisheries by S S Khanna and H R Singh,
3. Handbook of Fish Biology and Fisheries, (Vol I & II) by Paul J. B. Hart and John D. Reynolds
4. Fish Biology by, C B L Srivastava.
5. Fauna of British India, including Ceylon & Burma – by Francis Day.
6. Indian Fishes and Fisheries – Jhingran.
7. Introduction to Fish Physiology – Dr. Lynwood S. Smith
8. An Introduction to fishes – S. S. Khanna
9. Ichthyology – K.F. Lagler, John F., Bardach, R. R. Miller and D. R. May Passino



# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VII

### **LABORATORY COURSE BASED ON ZOO-DSE-701**

**ZOO-DSE-702**

**Credits: 02**

**Time: 30 Hours**

**Max Marks: (20+30)**

1. Identification of Fishes with Suitable Examples from each group.
2. Study of different types of Scales from Permanent Slides/Freshly Prepared slides from Fish Specimens.
3. Study of Structure of Weberian Ossicle in Fish.
4. Study the internal anatomy of fish
  - Alimentary Canal
  - Structure of gills and Swim bladder
  - Reproductive system.
5. Study of the food items in gut and determination of gastro-somatic index for a given fish.
6. Determination of age in fishes using scales.
7. Calculation of gonadosomatic index for given fish specimen.
8. Any other practical found feasible by the teacher approved by Head/ Coordinator & Dean.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VII

### MEDICAL ENTOMOLOGY

**ZOO-DSE-703**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Biology of Medically Important Insects**

**15 Hours**

Diptera: Mosquitoes (Anopheles, Aedes, Culex), Housefly, Horsefly, Tsetse fly and Sand fly. Hemiptera: Bed bugs. Siphonaptera: Flea. Siphunculata: Head louse, Body louse and pubic louse. Dictyoptera: Cockroaches.

#### **Unit II: Insect Ecology & Behaviour**

**15 Hours**

Insects and climate: Temperature, Light, Rainfall, Wind and Influence of Climate change. Insect population dynamics: Population functions and factors affecting population size. Climate change and its influence on Malaria in India. Community ecology: Classes of interaction, factors affecting interaction and consequences of interaction. Insect behavior: mating, feeding and defensive strategies.

#### **Unit III: Arthropod-Borne Diseases**

**15 Hours**

Bacterial diseases - Plague, Rickettsiosis, Bartonellosis. Viral disease – Dengue, Japanese Encephalitis, Chikungunya, Zika. Protozoan diseases – Leishmaniasis, Malaria, Trypanosomiasis. Helminthic diseases – Filariasis (Wuchereria, Brugia, Loa). Direct injury, Annoyance, Allergies, toxins, myiasis and venomous arthropods. Insects as vectors of human diseases

#### **Unit IV: Agricultural and Veterinary Pests**

**15 Hours**

Cereal crop pests (Maize, Wheat, Paddy, Sugarcane). Fruit and vegetable pests (apple, cucurbits, mango) Stored grains and household pests. Forest pests, Insect parasitism and Major Veterinary pest.

#### **Suggested Readings**

1. Medical and Veterinary Entomology, 2nd Ed., Gary Mullen & Lance Durden.
2. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods, Revised Edition. by Bruce Eldridge & John Edman.
3. Medical Toxicology by Richard C. Dart. Pub: Lippincott Williams & Wilkin.
4. Manual of Medical Entomology by Deane P. Furman & Paul Catts.
5. Infectious Diseases of Arthropods by Goddard.
6. Medical Entomology for Students 5th edition by Mike Service.
7. General and Applied Entomology by David and Ananthakrishnan.
8. Destructive and Useful Insects by R. L. Metcalf.
9. Ecology of Insects by Martin R. Speight Pub: Wiley-Blackwell.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester-VII**

#### **LAB COURSE BASED ON ZOO-DSE-703**

**ZOO-DSE-704**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Insect Collection and Preservation methods.
2. Collection of medically important Insects and identification up to genus level.
3. Maintenance and study the stages life cycle of Cockroach / house fly / mosquito.
4. Preparation of permanent mounts of mosquito respiratory siphon and trumpet.
5. Collection and Identification of Pests attacking Paddy in Kashmir.
6. Collection, preservation and Identification of the pests attacking Apples, Pear & Peach.
7. Survey, collection and preservation of stored grain pests.
8. Preparation of whole mount of small insects-Aphids, Head louse, Bird louse, Thrips etc.
9. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester VII**

#### **ORGANIC FARMING**

**ZOO-SEC-701**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: 40+60**

#### **Unit I: Concept of Organic Farming**

**15 Hours**

Introduction of organic farming. Principles of organic farming. Types of organic farming and benefits of organic farming. Scope of organic farming. Conventional farming v/s organic farming. Requirements of organic farming.

#### **Unit II: Organic Plant Nutrient Management**

**15 Hours**

Organic farming systems- soil tillage, land preparation and mulching. Propagation of seeds, planting material and seed treatment. Green manuring. Composting -Principle, stages, types and factors. Vermicomposting. Biofertilizers-types

#### **Unit III: Organic Plant Protection & Production**

**15 Hours**

Plant protection- Cultural, Mechanical. Botanical pesticides and Biopesticides. Biological control agents. Microbial control. Weed management. Organic crop production methods for Rice & Medicinal plants.

#### **Unit IV: Organic Production and Certification Agencies**

**15 Hours**

National programme for organic production. National standards and norms for Organic certification. National and International organic certification agencies, quality consideration, Inspection, processing and handling, marketing and export.

#### **Suggested Readings:**

1. Dahama, A. K. 2005. Organic Farming for sustainable agriculture. Agrobios (India) Jodhpur.
2. Gahlot, D. 2005. Organic Farming. Agrobios (India) Jodhpur.
3. Palaniappan, S. P. and Anandurai, K. 1999. Organic Farming. Theory and Practices. Scientific Publication Jodhpur.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester VIII GENERAL ENDOCRINOLOGY**

**ZOO-CC-801**  
**Credits: 04**

**Time: 60 Hours**  
**Max. Marks: (40+60)**

#### **Unit I: Endocrine Glands, Structure and Functions** **15 Hours**

Hypothalamus: Structure and Function, Hypothalamo-hypophyseal Complex, hormones of Adenohypophysis and Neurohypophysis; Thyroid Gland: Structure and its hormones, their function and Disorders, Regulation of thyroid secretions; Parathyroid Gland and its hormones, Role PTH and Calcitonin in maintaining  $\text{Ca}^{2+}$  level of Blood; Adrenal Gland: Structure and hormones of Adrenal Cortex and Medulla, their Functions and Disorders; Pineal and Thymus Gland: structure and their hormones.

#### **Unit II: Hormones and their Biosynthesis** **15 Hours**

Characteristics of hormones, Classification of hormones, Chemical Nature of hormones; Mechanism of Hormone Action: the cAMP mechanism and hormone receptors; Biosynthesis of Steroid Hormones, Biosynthesis of Thyroid Hormones, Biosynthesis of Corticosteroids, Biosynthesis of Adrenal Medullary Hormones, Synthesis of Insulin Hormone and mechanism of action.

#### **Unit III: Hormonal Control of Metabolism and Reproduction** **15 Hours**

Pancreas (Islets of Langerhans); Location and Structure, Pancreatic hormones, and its Regulation; Gastro-Intestinal hormones and Endocrine Regulation of Digestion; Role of hormones in the differentiation of Male and Female Gonads; Hormonal Regulation of Gametogenesis, Hormonal Regulation of Reproductive Cycles, Role of Hormones in Pregnancy, Parturition and Lactation; Placental Hormones (HCG, HCS, PMSG).

#### **Unit IV: Hormonal Regulation and Behaviour** **15 Hours**

Role of hormones in animal migration, Hormonal regulation of Biological Rhythms; Role of hormones in Parental Care of animals, Role of Vasopressin in Mammals, Hormonal regulation of mating behaviour; Regulation of Water and Electrolytes by Mineralocorticoids, Renin-Angiotensin System; Role of Neuro-hypophyseal hormone in the Osmoregulation of fishes, Hormonal Regulation of Osmoregulation in Amphibians, Role of hormones in Osmoregulation of Terrestrial Vertebrates.

#### **Suggested Readings:**

1. Bantley, P.J. (1976): Comparative vertebrate Endocrinology, Cambridge Univ. Press, U.K.
2. Norris, O Davia: Vertebrate Endocrinology
3. Williams Text book of Endocrinology (1998). W.B. Saunders Company.
4. Hadley MaE and Levine, J.E. (2006): Endocrinology by Addison-Wesley
5. Barrington, E.E.W.: An introduction to Compar. Endocrinology, Willey Eastern Pvt. Ltd. USA.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester VIII

### CELL AND MOLECULAR BIOLOGY

**ZOO-CC-802**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Cell Membrane: Structure & Function**

**15 Hours**

Structure and composition of cell membrane; Integral membrane proteins and Peripheral membrane proteins and their properties, Membrane lipids; Phospholipids, Sphingolipids and Cholesterol and their role in membrane fluidity, membrane transport proteins, active and passive transport across cell membrane, Endocytosis and Exocytosis, Modification of cell membrane; Microvilli, Cilia and Flagella. Mitochondrial membrane, Chemiosmotic theory, Oxidative phosphorylation

#### **Unit II: Cell Organelles and Extracellular Matrix**

**15 Hours**

Protein Glycosylation in Golgi Complex, Role of ER in Protein Segregation. Coated Vesicle and Receptor Mediated Selective Transport (COPI&COPII Coated Vesicles), Structure of Nuclear Membrane - Nuclear Pore Complex, Nucleolus, Organisation, Structure and Function of Centrioles and Basal Bodies, Microtubules Organising Centres(MTOCs), The Extracellular Matrix-Collagen, Elastin, Fibrin, Fibronectin, Laminin and Proteoglycans.

#### **Unit III: DNA Replication and Repair**

**15 Hours**

DNA Replication; Types, Mechanism of DNA Replication in Prokaryotes and Eukaryotes, Enzymes and necessary Proteins in DNA Replication, Inhibitors of DNA Replication, Telomeres, Telomerase and Replication, Role of Telomerase in aging, DNA Repair; Photo-Reactivation, Excision Repair, Direct Repair, SOS Response System of DNA Repair in *E. coli*

#### **Unit IV: Transcription, Translation and Gene Regulation**

**15 Hours**

Transcription and Processing of RNA in Prokaryotes and Eukaryotes, Enzymes involved in Transcription, 5' Cap and Poly A tails in mRNA, Pre-mRNA Processing, Alternative Splicing, Transport of mRNA across the Nuclear Envelope. Translation; Mechanism of Initiation, Elongation and Termination in Prokaryotes, and Eukaryotes, Regulation of Translation. Gene Regulation in Prokaryotes, Lac Operon and Tryptophan Operon

#### **Suggested Readings:**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Edition. John Wiley & Sons, Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Publishing Inc, 2000.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester VIII**

#### **CANCER BIOLOGY**

**ZOO-CC-803**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

#### **Unit I: Cancer and its Prevention**

**7 Hours**

Cancer and Carcinogens; Characteristic features of normal and cancerous cells; types of Cancer, Cause of Cancer, Cancer Angiogenesis, invasion and metastasis; Prevention of cancer: healthy life style, medicine and other pathways. Role of nutrition in Cancer Management

#### **Unit II: Cancer Diagnostics and Management**

**8 Hours**

Diagnosis of Cancer: Radiological (X-ray, Ultrasonography, CT Scan, MRI, PET Scan); Cytological(FNAC); Histological (Biopsy); Haematological; Tumour Markers; Treatment and Treatments of cancer: (radiotherapy, chemotherapy, immunotherapy, transplantation, and other modern modes in the Cancer therapeutics).

#### **Unit III: Cell Cycle, Viruses and Cancer**

**7 Hours**

Cell Cycle mutation and cancer, Chromosome Rearrangements and Cancer. Telomerase and Cancer. Genetic Pathways to Cancer, Tumor inducing viruses: Hepatitis B viruses, SV40 and Polyomaviruses, Papilloma viruses, Adenoviruses, Herpes viruses, Retroviruses.

#### **Unit IV: Genetics of Cancer**

**8 Hours**

Oncogenes and functions, Tumor-Inducing Viral Oncogenes, The Proto-Oncogenes, Mutant Cellular Oncogenes and Cancer, Tumor suppressor genes, Function of tumor suppressor genes, Inherited Cancers and Knudson's Two-Hit Hypothesis, Cellular Roles Of Tumor Suppressor Proteins, pRB, pAPC, p53, pMSH2, pBRCA1 and pBRCA2,

#### **Suggested Readings:**

1. Kenneth offit, "Clinical cancer genetics risk counseling and management" 1st edition 1998.
2. Fred Bunz "Principles of cancer genetics" springer science.
3. Kleinsmith – Principles of Cancer Biology.
4. P.R. Burch – The Biology of Cancer: A New Approach.

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester VIII**

#### **LABORATORY COURSE BASED ON ZOO-CC-801, ZOO-CC-802 & ZOO-CC-803**

**ZOO-CC-804**

**Credit: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

1. Study of endocrine glands: Pituitary, Thyroid, Parathyroid, Adrenal and Pancreas through laboratory model /chart
2. Histological study of different endocrine glands using permanent slides (Pituitary, Thyroid, Parathyroid, Adrenal and Pancreas)
3. To study effect of testosterone on chick comb.
4. To study effect of Thyroxine on metamorphosis.
5. Extraction of pituitary gland from fish.
6. Isolation of DNA and Estimation of DNA (diphenyl method)
7. Estimation of RNA (Orcinol method)
8. Agarose gel Electrophoresis of DNA
9. DNA amplification by PCR
10. Gel Documentation
11. Histology of benign tumors.
12. Preparation of pedigree analysis.
13. Population survey of cancer incidence and etiology in Kashmir.
14. Any other practical found feasible by the teacher approved by the Head/ Coordinator and Dean.



Semester VIII

**PARASITE IMMUNOLOGY & EMERGING PARASITIC DISEASES**

**ZOO-DSE-801**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

**Unit I: Immunological and Hematological Response**

**15 Hours**

Immune and hematological responses against important **Protozoan** - *Entamoeba histolytica*, *Plasmodium* spp. **Trematode** – Fasciola; **Cestode** – Taenia; and **Nematode Parasites** - Ascaris: Immunoregulatory mechanisms associated with evasion of host immunity. Haematological and serological changes in relation to parasitic diseases in small ruminants.

**Unit II: Clinical Parasitology**

**15 Hours**

History of clinical parasitology, clinical signs, gross and microscopic examination of parasitic infections, Specimen Collection and Processing of protozoan and helminth parasites. Diagnosis of parasitic infections; Histopathology of the infected organs of the sheep and fish. Cryopreservation of parasites.

**Unit III: Control and Management of Parasitic Diseases**

**15 Hours**

Antiparasitic drugs; Their Classification. Conventional and novel methods for control of helminths. Anthelmintic; characteristics of an ideal anthelmintic - mode of action, spectrum of activity, anthelmintic resistance, delivery devices, integrated control method and formulation of deworming schedule.

**Unit IV: Emerging & Re-emerging Diseases**

**15 Hours**

Introduction to emerging & re-emerging diseases, factors, responsible for the emergence and re-emergence of infectious diseases. Causes, mode of transmission and prevention of following emerging diseases: Malaria, Dengue, Tick borne encephalitis, Flavobacterial diseases & Rift Valley fever. Impact of climate change on the emergence and reemergence of parasitic diseases

**Suggested Readings:**

1. Kindt TJ, Goldsby RA & Osborne BA. 2007. Kuby Immunology. 6th Ed. WH Freeman.
2. Male D, Brostoff J, Roth DB & Roitts I. 2007. Immunology. 7th Ed. MosbyElsevier.
3. Tizard IR. 2004. Veterinary Immunology: An Introduction. 7th Ed. Saunders/Elsevier.
4. Detrick B & Hamilton RG. (Eds). 2006. Manual of Molecular and Clinical Laboratory Immunology. 7th Ed. American Society for Microbiology.
5. Rose NR, Friedman H & Fahey JL. (Eds). 1986. Manual of Clinical Laboratory Immunology. American Society for Microbiology.

**Semester VIII**

**LABORATORY COURSE BASED ON ZOO-DSE-801**

**ZOO-DSE-802**  
**Credits: 02**

**Time: 30 Hours**  
**Max. Marks: (20+30)**

1. Identification and observation of parasitic stages in host animals.
2. Collection, processing and examination of faecal samples for parasitological findings.
3. Blood examination of host animals for blood parasites.
4. Study of helminth parasites of vertebrates through prepared Slides.
5. Methods of collection of helminth parasites from vertebrates.
6. Fixatives, Preservatives and methods of fixation & preservation of helminth parasites from vertebrates.
7. Permanent stained whole mount preparation of Trematodes, Cestodes and Acanthocephala from some vertebrates.
8. Temporary & permanent whole mount preparation of nematodes from some vertebrates.
9. Identification of species on the basis of anatomical and morphological characteristics in cestodes.
10. Collection of Ectoparasites from some ruminants.
11. Collection, processing and permanent preparations of Ectoparasites from birds
12. Immuno-electrophoresis.
13. Direct and Indirect hemagglutination.
14. Complement fixation.
15. Ouchterlony Gel diffusion test
16. SDS - PAGE
17. Any other practical found feasible by the teacher approved by the Head/ Coordinator and Dean.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester VIII**

### **ORNAMENTAL FISHERIES**

**ZOO-DSE-803**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Introduction to Ornamental Fisheries**

**15 Hours**

Ornamental Fisheries: Definition and Scope; History of ornamental fisheries: Present global and national scenario; world trade of ornamental fish and export potential, different varieties of exotic and indigenous fishes used in ornamental fisheries; a new dimension in aquaculture entrepreneurship, challenges and opportunities of aquarium fisheries in Kashmir

#### **Unit II: Ornamental Fishes and Plants**

**15 Hours**

Characteristics features of Ornamental fishes; Ornamental fishes of world/J&K; Biology of some selected indigenous Indian ornamental Fishes: Egg layers and Live bearers; Introduction to aquarium plants and their export potential; Aquarium plant propagation; management of ornamental aquatic plants

#### **Unit III: Aquarium Designing and Equipment**

**15 Hours**

Introduction to aquarium construction: Designing, settings and maintenance of aquarium; types of aquarium: Freshwater and marine aquaria; Aquarium accessories: Tanks, Aerators, filters, heaters and lighting; Biofilters in aquarium.

#### **Unit IV: Feeding, Breeding and Diseases Management**

**15 Hours**

Preparation of feed for tropical and temperate ornamental fish; breeding of ornamental fish with reference to selected egg layer species: Gold fish and egg bearer species: Guppies and mollies. Diseases in ornamental fishes and their treatment, health management in ornamental fish farming.

#### **Suggested Reading:**

1. A Complete manual on ornamental fisheries by Srinivasan Muthurilappan
2. Ornamental fish culture and aquarium management by A D Kholakia
3. Home aquarium and ornamental fish culture by C S Tharadevi and N Arumugam
4. Fish & Fisheries in India – By Jhingran V.G. – Hindustan Pub. Corporation – New Delhi.
5. Hand Book of Fresh Water Fishes of India by Beaven C.R. – Narendra Pub. House.
6. Fish Biology by C.B.C. Srivastava – Narendra Pub. House.
7. Ecological Methods for Field & Laboratory Investigations by P. Michael.
8. Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing News Books (1988).

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester VIII**

#### **LABORATORY COURSE BASED ON ZOO-DSE-803**

**ZOO-DSE-804**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

1. Identification of common ornamental fishes-Gold fish, Koi carp, Danio, Molly, sword tail etc.
2. Identification of locally available ornamental fishes in Kashmir.
3. Identification of aquarium plants
4. Identification of ornamental fish diseases and prophylactic measures
5. Introduction to Aquarium accessories and equipment.
6. Setting-up and maintenance of aquarium
7. Conditioning and packing of ornamental fishes
8. Construction of an aquarium.
9. Any other practical found feasible by the teacher approved by the Head/ Coordinator and Dean.

**Semester VIII**

**ENVIRONMENT AND SUSTAINABLE DEVELOPMENT**

**AEC-103-ESD**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

**Unit I: Concept of Environment**

**15 Hours**

Environment, Definition, Scope and importance, Concepts of ecosystem, Food chain and food web, Biogeochemical cycles (oxygen, carbon and nitrogen) Biodiversity, types, Cause of loss and strategies for Conservation. Environmental feminism, Environmental movements (Chipko, Appiko).

**Unit II: Environmental Issues and Protection**

**15 Hours**

Environmental Pollutions. Definition, Causes, Consequences and control of Air, Water, Soil and Noise. Solid Wastes and management, Global warming, Acid rain. Concept of Atmosphere, Ozone layer depletion. Greenhouse effect, Water & Air Act, Environmental Protection Act 1986, amendments and rules.

**Unit III: Biogeography of India, Habitats and Resources**

**15 Hours**

Biogeographical regions of India and their salient features, Classification, function and values of habitats – Freshwater wetlands, deserts, grasslands and forests, Concepts of natural resources – renewable and non-renewable resources, Overexploitation of resources – deforestation, water table depletion and land degradation.

**Unit IV: Sustainable Development**

**15 Hours**

Principles of sustainable development, History and emergence of the concept, Sustainable development and international contribution, Socio-economic policies for Sustainable development, Summits, agreements and Conventions for implementing sustainable development, Sustainable developments through trade.

**Suggested Readings:**

1. Environmental Management, Sustainable Development and Human Health by Eddie N. Laboy-Nieves, Eddie Nelson Laboy, CRC Press, 2008
2. The human impact on the natural environment: past, present, and future by Andrew Goudie. Wiley-Blackwell, 2006.
3. The Economics of Sustainable Development: The Case of India by Surender Kumar, Shunsuke Managi. Springer
4. Dimensions in Environmental and Ecological Economics by Sahu, Nirmal Chandra & Choudhury, Amita Kumari, Environment and Bio 5. An Introduction to Biodiversity by Goel, B R.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester IX

### ADVANCED DEVELOPMENTAL BIOLOGY

**ZOO-CC-901**

**Credit: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Mechanism of Gametes Fusion**

**15 Hours**

Structure of egg and sperm, External fertilization in Sea Urchin; Recognition of egg and sperm, acrosomal reaction, fast and slow block to polyspermy, Role of Calcium in initiation of cortical reactions and activation of egg metabolism. Internal fertilization in mammals; Translocation of gametes and capacitation, Thermotaxis and chemotaxis for sperm attraction, Recognition at the Zona pellucida, Gamete fusion and Prevention of polyspermy.

#### **Unit II: Embryonic Development and Sex Differentiation**

**15 Hours**

Primary Axis formation in *Drosophila* during oogenesis, Anterior-posterior polarity of oocytes, Dorsal-ventral patterning in the oocytes, Protein gradient in early embryo, The Cartesian Coordinate Model; *Coenorhabditis elegans*: antero-posterior, dorsolateral and right-left axes formation, Vulva formation in *C. elegans*. Sex differentiation in humans.

#### **Unit III: Chick Embryology**

**15 Hours**

Structure of fertilized egg, Cleavage and Blastulation, Fate map of chick blastula, Gastrulation and morphogenetic movements in the chick development, Neurulation and Somatogenesis, Chick development during, 24 hours, 48 hours and 72 hours of incubation, Avian organizers, Anterior-posterior patterning, Left-right axis formation.

#### **Unit IV: Reproductive Disorders and Technology**

**15 Hours**

Menstrual disorders; Precocious, delayed or absent puberty; Amenorrhea, Fertility disorders; Sexual dysfunction, Infertility, Spontaneous pregnancy loss. Pregnancy disorders; Pre-eclampsia, IUGR, Labour abnormalities. Endocrine disorders; Hyperprolactinemia Autoimmune disorders. Techniques; Semen analysis, Ovulation induction, Oocyte retrieval, In vitro maturation, In vitro fertilization, ICSI, GIFT etc. Cryopreservation of gametes & embryos, Vitrification Embryo biopsy; Embryo hatching Pre-implantation genetic diagnosis (PGD), Prenatal diagnostic techniques: Amniocentesis, ultrasonography, chorionic villus sampling. Teratogenesis, genetic and environmental developmental mechanisms of teratogenesis.

#### **Suggested Readings**

1. Gilbert and Barresi (2016) Developmental Biology, Sunderland (Massachusetts)
2. Wolpert, L, Tickle, C, Arias, A.M. (2015) Principles of Development. pp 695. Oxford University Press.
3. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Sinauer Associates, Sunderland.
4. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
5. Genes in Population by Spiess. E (1989) 2nd Edition. Wiley-Liss, New York.
6. Evolutionary Biology by Futuyma. D (1997) 3rd edition, Sinauer Associates.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester IX**

### **IMMUNOLOGY**

**ZOO-CC-902**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Introduction to Immune System**

**15 Hours**

The Immune system – Innate and adaptive immunity, humoral and cell-mediated immune responses; Cells of the immune system (Phagocytes, NK cells, Mast cells & basophils and dendritic cells); Innate molecular defense system (The complement system, Acute phase proteins and cytokines); Toll like receptors; Inflammation; The Lymphoid tissues – primary and secondary lymphoid organs (MALT); Lymphocyte traffic and recirculation; Origin and maturation of T and B lymphocytes, Self/Non self-recognition, T and B cell activation, Clonal selection of lymphocytes;

#### **Unit II: Antigen-Antibody Nature and Complement System**

**15 Hours**

Antibodies – Structure, Classes of immunoglobulins, Antibody genes, Monoclonal and polyclonal antibodies; Antigens – factors affecting immunogenicity of an antigen, Epitopes of antigen – Features of B- and T- cell epitopes, Haptens, Antigen processing and presentation –Cytosolic and Endocytic pathways of Antigen processing; Antigen-antibody interactions – Antibody affinity, antibody avidity, cross reaction; Complement system – Classical, alternative and Lectin pathways, Major Histocompatibility Complex (MHC) structure and function; genetic control of Immunoresponses; MHC restriction

#### **Unit III: Hypersensitivity Reactions and Autoimmune Diseases**

**15 Hours**

Hypersensitivity – Classification of hypersensitivity reactions; Type-I – Anaphylactic hypersensitivity; Type – II Antibody – mediated cytotoxic hypersensitivity. Type-III – Immunocomplex mediated hyper sensitivity; Type – IV Cell mediated (Delayed) hypersensitivity. Autoimmune diseases – Organ specific auto immune diseases – Grave's disease, insulin-dependent diabetes mellitus (type-I diabetes); Systemic autoimmune diseases – Systemic Lupus Erythematosus (SLE), Rheumatoid arthritis. Genetic factors, pathogenesis and treatment of autoimmune diseases.

#### **Unit IV: Transplantation and Tumour Immunology**

**15 Hours**

Transplantation – Historical perspective, Types of grafts – allograft, autograft and xenograft; rejection problem; Transplantation antigens – blood group & MHC; Rejection mechanisms; Prevention of graft rejection (Familial grafting, tissue typing, cross matching, immunosuppression and fetal transplant); Origin and host defense against tumors, Tumor antigens, Immune responses to tumors, Immunodiagnosis, Cytokine and cellular immunotherapy of tumors, Immunotherapy of tumors with antibodies, Tumor vaccines.

#### **Suggested Readings**

1. Immunology, Kuby, W.F.Freeman, U.S.A
2. Fundamentals of Immunology, W.Paul
3. Essentials of Immunology, I.M.Roitt
4. Immunology A Foundation Test by Basiro Davey
5. An introduction to immunology, by Ian R. Tizard

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester IX

### GENETIC ENGINEERING

**ZOO-CC-903**

**Credits: 02**

**Time: 30 Hours**

**Max. Marks: (20+30)**

#### **Unit I: Tools of Genetic Engineering**

**7 Hours**

Restriction modification systems: Types and Nomenclature, restriction maps. DNA modifying enzymes and their Applications (Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Phosphatases, Reverse Transcriptase, Exonucleases, Endonucleases, Ligases) Cohesive and blunt end ligation - linkers and adaptors. Nick translation, Random priming, Radioactive and non-radioactive probes.

#### **Unit II: Vectors**

**8 Hours**

Vectors- Types, Definition and Properties. Plasmid vectors: pBR 322, pUC19, lac, T7 promoter vectors, Complementation (blue-white screening). Bacteriophage vectors: Insertion and replacement vectors, Cosmids, M13 Vectors, Yeast expression vectors (YEP & YIP). Shuttle vectors, artificial chromosome vectors: YAC and BAC.

#### **Unit III: Genetic Engineering Techniques**

**7 Hours**

Polymerase chain reaction – Principle, types and applications. Properties of primers. DNA pols used for PCR (high fidelity DNA pol), Reverse transcriptase PCR (RT-PCR). Real time/quantitative PCR. TA Cloning. DNA sequencing (Maxam-Gilbert, Sanger & pyro-sequencing). Site directed mutagenesis (primer extension, PCR and cassette mutagenesis). Yeast two-hybrid system.

#### **Unit IV: Gene Transfer and Applications**

**8 Hours**

Different methods of transfer of DNA (Transformation, electroporation, microinjection) into cells (Bacterial, animal and plant cells). Genomic and cDNA libraries. Chromosome walking and Jumping. Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines

#### **Suggested Reading:**

1. Brown TA (2016) Gene Cloning and DNA Analysis: An Introduction, Wiley-Blackwell
2. Christopher Howe (2007) Gene Cloning and Manipulation Cambridge University Press;
3. Primrose SB, Twyman R and Old B (2001) Principles of Gene Manipulation, Wiley-Blackwell
4. Reece J Richard (2003) Analysis of Genes and Genomes, Wiley-Blackwell
5. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
6. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.



## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester IX**

#### **LABORATORY COURSE BASED ON ZOO-CC-901, ZOO-CC-902 & ZOO-CC-903**

**ZOO-CC-904**

**Credit: 04**

**Time: 60 Hours**

**Max. Marks: 100**

1. Chick - Study of developmental stages - primitive streak, 24h, 36h, 48h, 72h, 96h (H.H. stages) through permanent slides.
2. Study of life cycle stages of *Drosophila*
3. Study of different types of eggs with reference to yolk content.
4. Observations on structure of egg in *Drosophila*.
5. Demonstration of lymphoid organs
6. Histological study of spleen, thymus and lymph nodes through slides/ photographs
7. Preparation of stained blood film to study various types of blood cells.
8. Agglutination test.
9. Demonstration of a) ELISA b) Immunoelectrophoresis.
10. Restriction digestion.
11. Primer designing.
12. Agrose gel electrophoresis.
13. Isolation of plasmid DNA.
14. Making of Competent cells.
15. Transformation.
16. Any other practical found feasible by the teacher approved by the Head/ Coordinator and Dean.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester IX**

### **INSECT STRUCTURE AND FUNCTION**

**ZOO-DSE-901**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Insect Morphology**

**15 Hours**

Insect Integument its structure and composition, Head Skeleton, Tentorium, Antennae, structure, types and functions, Types of mouthparts their modifications. Thorax- structure, segmentation and skeleton, Wings- structure, modifications and Coupling mechanism. Legs- structure and modifications, Abdomen segmentation, skeleton and appendages.

#### **Unit II: Insect Anatomy**

**15 Hours**

Digestive system- structure of alimentary canal and its modifications, salivary glands and their modifications, Terrestrial and Aquatic respiratory organs in insects, Excretory organs- Structure of Malpighian tubules, Nervous system, structure and its modifications, Neurosecretory cells and their role; Circulatory system in insects, Visual organs; Dorsal ocelli, Stemmata, Compound eye.

#### **Unit III: Insect Physiology**

**15 Hours**

Physiology of digestion- digestive glands and their secretions, Peritrophic membrane and its function, Physiology of Excretion and osmoregulation, Mechanism of Gaseous exchange, Physiology of Gills and Plastron respiration, Mechanism of Circulation, Composition of Haemolymph and functions of different types of cells, Intermediary metabolism.

#### **Unit IV: Insect Reproduction and Development**

**15 Hours**

Structure of male and female Reproductive organs and associated glands, Early embryonic development in insects, Post-embryonic development, Insect larvae, characteristics and their types, Insect pupae, characteristics and types, Role of hormones in post-embryonic development of insects and Diapause.

#### **Suggested Readings:**

1. Tembhare, D.B. Modern Entomology (Himalaya Publ. House)
2. Mani, M. S. General Entomology. (Oxford & IBH Publ. co. pvt. Ltd.)
3. Mani, M. S. Insects. (National Book Trust, India).
4. Klowden, M. J. Physiological systems in insects, Third Edn.
5. James L. Nation Sr. Insect physiology and Biochemistry.
6. Lawrence Gilbert, Insect Endocrinology (Elsevier Science Pub. Co. Inc)

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester IX**

#### **LABORATORY COURSE BASED ON ZOO-DSE-901**

**ZOO-DSE-902**

**Credits: 02**

**Time: 30 Hours**

**Max Marks: (20+30)**

1. Major dissection: To expose Digestive system, Excretory system, Reproductive system in Grasshopper, Honey bee & Cockroach.
2. Minor dissection: Temporary mount preparation of pollen basket, sting apparatus of honey bees, salivary glands of Cockroach.
3. Temporary mount preparations of Malpighian tubules & trachea.
4. Temporary mount preparation of different types of blood cells in insects.
5. Taxonomy and Identification of economically important genera of the following orders: Collembola, Thysanura, Odonata, Ephemeroptera, Orthoptera, Dictyoptera, Thysanoptera, Isoptera, Hemiptera, Siphunculata, Mallophaga, Diptera, Coleoptera, Lepidoptera, Hymenoptera.
6. Studies of different developmental stages (Nymphs, Naiads, Larva, pupa etc) of insects.
7. Temporary mount preparations of Antennae, wings, legs, pretarsus, Halteres, mouthparts & genitalia of Grasshoppers, Dragonfly, Housefly, mosquitoes, Honeybee.
8. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

# Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS

## Semester IX

### ANIMAL RESOURCES

**ZOO-DSE-903**

**Time: 60 Hours**

**Credits: 04**

**Max. Marks: (40+60)**

#### **Unit I: Insect Resources**

**15 Hours**

Importance and scope of insect based industries; Silkworm breeds, synthesis of silk and cocooning, harvesting and grainage; Apiculture products and apitherapy (honey, beeswax, bee pollen, propolis, royal jelly, bee venom); Lac products, properties and their uses (lac dye, lac wax, shellac, bleached shellac, dewaxed bleached shellac, aleuritic acid); Edible insect industry.

#### **Unit II: Fish Resources**

**15 Hours**

Fish resources of J&K, Fish monoculture, polyculture and composite culture; Pearl and shellfish farming; Integration of aquaculture with agriculture and animal husbandry; Natural and artificial breeding in fish; Genetic approach to fisheries; Fish as a food commodity; Fish by-products; Processing and preservation of fish and its products.

#### **Unit III: Livestock Domestication**

**15 Hours**

History of domestication; Important breeds of livestock (cow, sheep, goat, buffalo) and poultry with special reference to economic characters; Important methods of selection and systems of breeding in farm animals and poultry birds; Genetic and phenotypic consequences and applications of inbreeding and out-breeding; Genetic basis of heterosis and its use.

#### **Unit IV: Animal Products and Processing**

**15 Hours**

Principles and practices for production of high quality milk; Pasteurization and sterilization; Utilization of various animal and poultry by-products: blood, fat, hides, bones, wool, hair, and feather; Use of biotechnological tools in improving animal productivity; Scope of meat, fish and poultry processing industry in India.

#### **Suggested Readings:**

1. Prost, P.J. (1962). Apiculture. Oxford and IBH, New Delhi
2. Hafez, E.S.E. (1962). Reproduction in Farm Animals, Lea and Fabiger Publishers
3. Srivastava, C. B. L. (1999). Fishery Science and Indian Fisheries. Kitab Mahal Publ.
4. Sardar Singh, Beekeeping in India. Indian Council of Agricultural Research. New Delhi
5. Wilson, Keith. A handbook of poultry practice. (ISBN 8177540697)
6. Watson, J.A.S. and Mills, W.J. 2005. Farm animals and their management.

**Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

**Semester IX**

**LABORATORY COURSE BASED ON DSE-903**

**ZOO-DSE-904**

**Credits: 02**

**Time: 60 Hours**

**Max. Marks: (20+30)**

1. Study of modifications in legs of honey bees.
2. Study of life history of silk worm by rearing.
3. Dissection of silk glands of the silk worm larva.
4. Preparation of permanent slides of mouth parts, spiracles and appendages of larva.
5. Identification of culturable fishes in Kashmir valley.
6. Demonstration of induced-breeding technology in cultured fishes.
7. Study of growth and age in fishes.
8. Field trips to an organised fishery.
9. Identification of various breeds of cattle, buffalo, sheep and goat.
10. Quality analysis of honey.
11. Any other practical found feasible by the teacher and approved by the Coordinator/Head and Dean.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester IX**

### **Nutrition & Health**

**ZOO-OGE-901**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Human Nutrition**

**15 Hours**

Concept And Definition Of Terms-nutrition, Malnutrition And Health Influence Of Nutrition On Human Health; Food, Classification Of Food; Classification Of Nutrients; Nutritional Deficiency; (Protein-Calorie Malnutrition, Vitamin And Mineral Deficiency; Therapeutic Diet/ Diet Therapy, Dietary Management Of Diseases; Nutritional Intervention Programs To Combat Malnutrition: Role Of ICDS, Significance Of Mid-Day Meal Programme In Combating Malnutrition In School Children's.

#### **Unit II: Public Health Diseases and Their Prevention**

**15 Hours**

Communicable Diseases: Polio, Hepatitis, Rabies, Aids; Non-communicable Disease/Life Style Diseases: Hypertension, Coronary Heart Disease, Stroke, Diabetes, And Obesity. Associated Risk Factors; Modifiable and Non-modifiable, Prevention and their Management.

#### **Unit III: Mental Health**

**15 Hours**

Definitions: Health And Types, Characteristics Of A Mentally Healthy Person; Adolescence And Problems Of Adolescence Warning Signals Of Poor Mental Health; Types Of Mental Illness; Causes Of Mental Ill Health; Alcoholism And Drug Dependence; Symptoms Of Drug Addiction, Withdrawal/De-addiction, And Management.

#### **Unit IV: Pollution and Its Impact on Human Health**

**15 Hours**

Concept of Pollution and Human Health, Respiratory Diseases of Pollution, Water Borne Diseases like Cholera, Typhoid and Giardiasis and their management. Food Intoxicants and Poisoning: Causes and Treatment. Toxins: Nature, Types, and Effects.

#### **Suggested Readings:**

1. Park's Textbook of Preventive and Social Medicine, 23rd Edition.
2. Sundar Lal Adarsh, 2009. Text Book of Community Medicine: Preventive and Social Medicine, CBS Publishers and Distributors.
3. The Nature of Nutrition: A Unifying Framework from Animal Adaptation to Human Obesity by Stephen J. Simpson, David.
4. Food Science And Nutrition Paper Back- 30 June 2012 By Sunetra Roday.
5. Gopalon C: Nutrition Foundation of India, Special Publication Service.

# **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

## **Semester X**

### **BIOSYSTEMATICS**

**ZOO-CC-10-01**

**Credits: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

#### **Unit I: Systematics and Taxonomic Procedure**

**15 Hours**

Introduction to taxonomy, systematics and classification. Contribution of systematics to Biology; Binomial and Trinomial nomenclature; Theories of Biological classification (Essentialism, Nominalism, Empiricism and Cladism); Taxonomic collections, Curating of collections, Identification; Taxonomic characters. The qualitative and quantitative analysis of variations. Types of taxonomic material viz., Holotype, Paratypes, Syntype, Lectotype and Neotype) -definitions & significance.

#### **Unit II: Taxonomic Publications & Rules of Nomenclature**

**15 Hours**

Definition and significance of taxonomic publication. Kinds of taxonomic Publications (Synopsis & Reviews, Revisions, Monographs, Atlases faunal work, Field guides, Manuals, Handbooks, Catalogues & Checklist etc.). Major features of taxonomic publications; Methods of preparation of taxonomic keys; Law of priority, Homonymy & Synonymy; Articles of ICZN regarding date of publication, validity of names (family-group, Genus-group & species-group).

#### **Unit III: Modes of Speciation**

**15 Hours**

Species concept (Typological & Biological- their advantages and limitations)); Sibling species, Polymorphic species; polytypic species; Allopatric, sympatric, stasipatric and parapatric species – definition, examples; factors, methods and their evolutionary significance; Effects of Geography and Ecology in speciation. Role of founder principle, bottleneck effect and genetic drift in speciation.

#### **Unit IV: Modern Tools**

**15 Hours**

Numerical Taxonomy-its definition, scope, application and limitations; Chemotaxonomy-prospects and limitations; Cytotaxonomy with reference to chromosomal number and structure-application and scope. Molecular taxonomy (based on DNA, RNA and Proteins) with reference to phylogeny. Concept and significance of DNA Barcoding; Taxonomic significance of C-value and C-value paradox.

#### **Suggested Readings:**

1. Ernst Mayr, 1960. Principles of Systematic Zoology
2. Simpson, A.J. Animal Species
3. Verma, A. 2015. Principles of Animal Taxonomy, Alpha Science.
4. Kapoor, V.C. 2017. Theory and Practice of Animal Taxonomy and Biodiversity, 8th Edn.
5. Simpson, G.G. 1961. Principles of Animal Taxonomy

## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester X**

#### **ANIMAL BEHAVIOUR**

**ZOO-CC-10-02**

**Credit: 04**

**Time: 60 Hours**

**Max. Marks: (40+60)**

##### **Unit I: Concept and Kinds of Behaviour**

**15 Hours**

Ethology, Ethogram, Significance of studying animal behaviour, Evolution of behaviour, Instinct and Learned behaviour, Patterns and objectives of behaviour, Altruism, Hamilton's Theory, Reciprocal Altruism, Kin selection Hypothesis, Aggression; Types and causes of aggression, Territorial behaviour, Categories and size of territories, Marking of territory, Territorial conflict, Functions of territoriality, Neural and Hormonal control of behaviour.

##### **Unit II: Learning and Communication**

**15 Hours**

Learning, Flexible learning; Habituation, Trial and error, Classical conditioning, Instrumental conditioning Restricted learning; Imprinting; Communication patterns and advantages; Auditory communication; High pitch and low pitched sounds; Echolocation in Bats; Infrasound communication in Elephant and whales; Visual Communication; Visual signals in non-human primates; Chemical and tactile communication; Pheromones types and their role in animal behaviour; Reticular Activating System (RAS).

##### **Unit III: Orientation, Migration and Biological Rhythms**

**15 Hours**

Orientation and categories; Types of Kineses and Taxes; Negative and positive orientation, Language of Honey bee; Migration in Birds; Types of Migration; Causes and advantages of Migration; Navigation in Birds; Biological Rhythms, Circannual Clocks, Circatidal Clocks, Circalunar Clocks, Semilunar Clocks, Circadian Clocks, Regulation of biological clocks.

##### **Unit IV: Social and Sexual Behavior**

**15 Hours**

Social Behavior and types, Social Organization in Insects and primates, Polyphenism, Eusociality, Costs and benefits of group living, Characteristics of social groups, properties of social societies, Mating systems, Monogamy, Polygamy, Leks, Harem, Promiscuity and their types, Courtship behaviour in animals, Parental care and its types, Factor affecting parental care, Sexual selection (Intra and intersexual) in mammals, Fischer's theory of runaway sexual selection, Handicap principle

##### **Suggested Readings:**

1. Animal Behaviour, Reena Mathur
2. Animal Behaviour, Arora, M.P.
3. Animal Behaviour: An evolutionary approach: Alcock, J., Sinauer Association. Sunderland, Massachsets, USA
4. Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley and Sons, USA
5. An Introduction to Animal Behavior, A. Manning and M.S. Dawkins, Cambridge University Press, UK



## **Syllabus for Five Year Integrated B.Sc.-M.Sc. Programme in Zoology under CBCS**

### **Semester X**

#### **WILDLIFE SCIENCES**

**ZOO-DSE-10-01**

**Credits: 04**

**Time: 60 Hours**

**Max Marks: (40+60)**

#### **Unit I: Wildlife Status and Adaptations**

**15 Hours**

Bird species identification through morphological studies, Morphological adaptations in bill and claws. Camouflage and mimicry in birds. Endangered fauna of India (Mammals, Birds, Reptiles). Distribution of major mammalian taxa like cervids, bovids, carnivores, and primates in India. Wildlife status in J&K. Threatened Birds of J & K. Concept of IUCN threat categories. Red Data book.

#### **Unit II: Geographical Distribution of Wildlife**

**15 Hours**

Biogeography and Biogeographic regions of India. Distribution of Wildlife in different biogeographical regions of India: - The Himalayan Mountain system, The Peninsular Indian sub-region, The Indian Desert, The Tropical rain forest region. Zoogeographical regions of the world and their characteristic wildlife. Eco-development, Ecotourism, village relocation in Protected areas.

#### **Unit III: Wildlife Census Techniques**

**15 Hours**

Sampling design and data collection, Methods of wildlife population estimation: Sample counts, Drive counts, Line transect method and concept of distance sampling, Point counts, Pugmark census, Pellet group count, and Mark-recapture. Bird ringing and banding, Vegetation sampling methods.

#### **Unit IV: Modern Techniques in Wildlife Studies**

**15 Hours**

Bio-telemetry system and its applications in wildlife, VHF, and satellite telemetry. Bio-loggers and hydrophones and their applications. Non-invasive techniques in Wildlife studies. Habitat Suitability Index, Use of Modelling approaches in wildlife studies. Remote Sensing and GIS: active and passive remote sensing. Types of platforms and scanning systems. Working principle, advantages, limitation and application of GPS.

#### **Suggested Readings**

1. Krausman, P.R. and Cain, W.J. 2013. Wildlife management and conservation, Contemporary Principles and Practices.
2. Frysell, J.M. and Sinclair, A.R.E. 2014. Wildlife Ecology, Conservation and Management.
3. Morrison, M. L. and Mathewson, H.A. 2015. Wildlife Habitat Conservation: Concepts, Challenges and Solutions (Wildlife Management and Conservation).
4. Rajesh Gopal, Fundamentals of Wildlife Management: Natraj Publishers.
5. Vivek Menon Indian Mammals: A Field Guide; Hachette India publishers.
6. Richard Grimmet, Birds of the Indian Subcontinent oxford publishers