

Choice Based Credit System (CBCS) Scheme for 1st Semester (Batch-2021 onwards)

Course Code	Course Title	Course Type	Hours / Week			Credits	Examinations / Marks	
			L	T	P		Internal Assessment	Term End Examination
ZOO21101CR	Animal Taxonomy and Phylogeny	Core	4	0	0	4	20 Marks	80 Marks
ZOO21102CR	Structure and Function of Invertebrates	Core	4	0	0	4	20 Marks	80 Marks
ZOO21103CR	Insect Anatomy and Physiology	Core	2	0	0	2	10 Marks	40 Marks
ZOO21104CR	Laboratory Course 01	Core	0	0	8	4	20 Marks	80 Marks
ZOO21105DCE	General and Medical Parasitology	Discipline Centric	3	0	0	3	15 Marks	60 Marks
ZOO21106DCE	Veterinary Parasitology	Discipline Centric	3	0	0	3	15 Marks	60 Marks
ZOO21107DCE	Laboratory Course 02	Discipline Centric	0	0	4	2	10 Marks	40 Marks
ZOO2101GE	Fundamentals of Wildlife	Generic Elective	2	0	0	2	10 Marks	50 Marks
ZOO2101OE	Fish Farming	Open Elective	2	0	0	2	10 Marks	50 Marks

GENERAL INSTRUCTIONS

1. A candidate has to obtain **24 credits per semester** i.e., **96 credits in two-year** programme (4 semesters).
2. Out of 24 credits in a semester, a candidate has to compulsorily obtain 14 credits from “**Core Courses**” (**CR**) while the remaining 10 credits can be obtained from the “**Electives**” in the following manner:
 - ▶ A candidate has to obtain 8 credits from his/her own Department as **Discipline Centric Electives (DCE)**.
 - ▶ 2 credits shall be obtained by a candidate from the Electives offered by the Departments other than his/her own. A candidate shall be free to obtain these 2 credits from the **Generic or Open Electives**.
 - ▶ A candidate has the option to opt for **MOOC's** in place of **GE/OE**.
3. Maximum Marks per Credit are 25 (One unit is equivalent to one credit).
4. One Credit in Theory is 16 Hours direct teaching learning; where as in Practical's and Tutorials it is 32 hours.

Course No.: **ZOO21101CR**
Total Credits: **4** (4 L + 0 T + 0 P)

Course Title: **Animal Taxonomy and Phylogeny**
Maximum Marks: **100** (20+80)

Course objective: To learn the basics of taxonomy, to upgrade on new taxonomical concepts at molecular level, to infer the evolutionary significance & examine different phylogenetic methods.

Course outcome: The learner shall acquire a broad knowledge on taxonomy and phylogeny of animals. The students shall learn the concepts and terms along with modern systematic classifications.

Unit I: Principles and Methods of Zoological Classification (16 Hours)

Systematics: terms & definitions, strategies of research in systematics, future of systematics; taxonomic characters: definition and kinds - morphological, physiological, molecular, ecological, behavioral and geographical; curating of collections: preparation of material, housing, cataloging, arrangement of collection, curating of types, exchange of material and loans; taxonomic keys: definition and kinds- bracket key, indented key and pictorial key.

Unit II: Principles and Application of Zoological Nomenclature (16 Hours)

ICZN: historical background, overview of terms, principles and articles; homonymy, synonymy and law of priority; typification: definitions, kinds and significance; taxonomic publications.

Unit III: Dimensions of Speciation (16 Hours)

Species concepts: morphological, biological and phylogenetic species concept; variations and their evolutionary significance; mechanism of isolation & speciation: allopatric, sympatric, peripatric and parapatric; concept of evolution: Pre & post Darwin era.

Unit IV: Trends in Taxonomy (16 Hours)

Cytotaxonomy: back ground, chromosome evolution with specific reference to primates and grasshoppers; molecular taxonomy: concept of phylogenetic systematics; phylogenetic tree reconstruction; DNA bar coding concept and significance; tools for sequence annotation: NCBI (Genebank), Nucleotide BLAST, Alignment & sequence analysis, MEGA & Phylogenetic tree.

Suggested Books / Reading Material

1. An Introduction to Taxonomy by T. C. Narendran
2. Animal Taxonomy by V.C. Kapoor
3. Biology by Campbell and Reece Pearson Education
4. Biosystematics & Taxonomy by R. C. Tripathi
5. Genomes by T. A. Brown BIOS
6. Organic Evolution by N Arumugam Saras Publication
7. Principles of Systematic Zoology by Ernst Mayr Tata McGraw Hill Publishing Company
8. Principles of Systematic Zoology by Peter D. Ashlock & Ernst-Mayr, Tata McGraw H. Pub. Comp.
9. Strickberger's Evolution by Brian K. Hall & Benedikt Hallgrimsson Jones

Course No.: **ZOO21102CR**
Total Credits: **4** (4 L + 0 T + 0 P)

Course Title: **Structure and Function of Invertebrates**
Maximum Marks: **100** (20+80)

Course objective: The course is a walk for students to go through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades.

Course outcome: To develop understanding on the diversity of life with regard to protists, non-chordates. The learner will utilize the knowledge gained from these creatures for the economy and human welfare

Unit I: Protozoa and Porifera (16 Hours)

Classification of protozoa up to order level; nutrition, locomotion, reproduction and economic importance of protozoa; classification of porifera up to order level; canal system, skeleton in porifera, reproduction and development; economic importance of porifera.

Unit II: Cnidaria and Helminths (16 Hours)

Classification of cnidaria up to order level; polymorphism in cnidaria; corals and coral reefs; economic importance of cnidaria; classification of helminths upto order level; larval forms of cestodes, trematodes & nematodes; general account of acanthocephala.

Unit III: Annelida and Arthropoda (16 Hours)

Classification of annelida up to order level; adaptive radiation in polychaetes; nervous system in annelids; economic importance of annelids; classification of arthropoda upto order level; respiration in arthropods (aquatic & terrestrial); crustacean larvae & their evolutionary significance; economic importance of arthropoda.

Unit IV: Mollusca and Echinodermata (16 Hours)

Classification of mollusca upto order level; foot and its modifications; torsion in gastropods; respiratory and nervous system in cephalopoda; colouration and ink in cephalopoda; classification of echinodermata up to order level; larval forms and their significance; water vascular system; autotomy & regeneration in echinodermata; economic importance of echinodermata.

Suggested Books / Reading Material

1. Barnes: Invertebrate Zoology, Holt-Saunders International, 4th edition, 1980
2. Barnes: The Invertebrates – A synthesis, 3rd edition, Blackwell, 2001
3. Brusca, R. C., Brusca, G. J., & Haver, N. (1990). Invertebrates. ed
4. Hunter: Life of Invertebrates, Collier Macmillan Pub. 1979
5. Marshall: Parker & Haswell Text Book of Zoology, Vol. I, 7th edition, Macmillan, 1972
6. Modern Text Book of Zoology: Invertebrates R. L. Kotpal
7. Moore: An Introduction to the Invertebrates, Cambridge University Press, 2001
8. Non-chordate Zoology by Dharmi, P. S. & Dharmi, J. K., R. Chand & Co
9. Pechenik, J. A. (2000). *Invertebrates* (Vol. 193). Singapore." McGraw Hill
10. Textbook of Invertebrate Zoology G. S. Sandhu & H. Bhaskar, 2004

Course No.: **ZOO21103CR**
Total Credits: **2** (2 L + 0 T + 0 P)

Course Title: **Insect Anatomy and Physiology**
Maximum Marks: **50** (10+40)

Course objective: To impart knowledge about insect anatomy and physiology

Course outcome: The learner can utilize the knowledge in understanding different organ systems in one of most dominated and diverse creatures of nature.

Unit I: Insect Anatomy (16 Hours)

Digestive system, respiratory system, circulatory system and excretory system; nervous system & reproductive system.

Unit II: Insect Physiology (16 Hours)

Physiology of digestion; physiology of respiration; physiology of circulation; physiology of excretion.

Suggested Books / Reading Material

1. Entomology by Cedric Gillott Plenum Press, New York
2. Fundamentals of Entomology by Richard J. Elizinga
3. Imm's General Text Book of Entomology vol.I by O. W. Richards & R.G. Davis Springer
4. Introduction to Entomology by Comstock
5. Modern Entomology by D. B. Tembhare Himalaya Publishing House
6. The Insects: Structure and Function by R. F. Chapman Cambridge University Press

Course Code: **ZOO21104CR**

Course Title: **Laboratory Course 01**

Total Credits: **4** (0 L + 0 T + 4 P)

Maximum Marks: **100** (20 + 80)

A. Presentation of field work by the students in presence of all faculty members (20 Marks)

B. Practical's. (80 Marks) Time: 128 Hours

1. Construction of taxonomic keys (Bracket key & Indented key)
2. Slide/Specimen study of Protozoa
3. Permanent mount preparation Protozoa
4. Slide/Specimen study of Porifera
5. Slide/Specimen study of Cnideria
6. Permanent mount preparation of Cnidaria (Obelia / Hydra)
7. Slide/Specimen study of Helminths
8. Slide study of larval forms of Cestodes and Trematodes
9. Specimen study of Annelida
10. Nervous system in Annelida (Earthworm / Neries)
11. Specimen study of Arthropoda
12. Mouth parts and sting apparatus of honey bee
13. Slide study of Larval forms of Crustacea
14. Permanent mount preparations of Crustacean larvae
15. Specimen study of Mollusca
16. Nervous system of Mollusca – Loligo / Sepia / Octopus
17. Specimen study of Echinodermata
18. Dissection of Star Fish so as to expose its digestive system and water vascular system
19. Museum study of common insect species to study their morphology
20. Minor dissection/temporary mount preparation of mouthparts, wings, and legs of Grasshopper, Cockroach, Housefly, and honey bees
21. Collection and study of various insect eggs
22. Collection, preservation and identification of different types of insects and their larvae

Suggested Books / Reading Material

1. A Manual of Practical Entomology by M. M. Trigunayat
2. A Manual of Practical Zoology by P. S. Verma
3. A Textbook of Invertebrate Practical Zoology by Vivekanand Banerjee
4. Practical Zoology: Invertebrate (English, Rastogi Publications, S.S.Lal)

(Value Added Course)

Course Code: **ZOO21105DCE**

Course Title: **General and Medical Parasitology**

Total Credits: **3 (3 L + 0 T + 0 P)**

Maximum Marks: **75 (15+60)**

Course objective: To acquaint the students about the knowledge of parasites of medical importance. To understand the nature of the parasites and parasitism, emphasizing the influence of parasites on the ecology and evolution and the role of parasites in global public health.

Course outcome: The learner becomes aware about the parasitic diseases & the consequences thereof. To understand the disease-causing potential of parasites and the responses of the immune system. To learn the mechanisms of transmission and pathogenicity caused by the parasites. To diagnose the causative agents, to understand the prophylactic measures and treatment of important parasitic diseases like malaria, leishmaniasis, trypanosomiasis, toxoplasmosis, schistosomiasis, etc.

Unit 1: Introduction to Parasitology

(16 Hours)

Animal associations with special emphasis on parasitism; origin, evolution and distribution of parasites in animal kingdom; parasitic adaptations; host parasite relationships & zoonosis.

Unit II: Protozoology

(16 Hours)

Morphology, life-cycle, pathogenicity & control of luminal protozoan parasites of man: *Entamoeba*, *Giardia* & *Trichomonas*; morphology, life-cycle, pathogenicity & control of blood protozoan parasites of man: *Leishmania* & *Trypanosoma*; pathogenicity & control of *Falciparum malaria* with special emphasis on immune-prophylaxis; opportunistic protozoan parasites of man: *Toxoplasma* & *Cryptosporidium*.

Unit III: Helminthology

(16 Hours)

General organization, reproduction and development in helminths; trematode parasites of man with life cycle, pathogenicity & control of *Shistosome*; cestode parasites of man with life cycle, pathogenicity & control of *Taenia*; nematode parasites of man with life cycle, pathogenicity & control of *Enterobius vermicularis* & *Ancylostoma duodenale*.

Suggested Books / Reading Material

1. Animal Parasitology by J. D. Smyth
2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
3. Foundations of Parasitology by Larry S. Roberts, John Janovy & Steve Nadler
4. General parasitology by Thomas C. Cheng
5. Georgis' Parasitology for Veterinarians 10th Edition Elsevier.
6. Helminthes Arthropods and Protozoa of Domesticated Animals by E.J.L. Soulsby
7. Introduction to Parasitology by A.S.A. Chandler & Clark P. Read
8. Monning's Veterinary Helminthology and Entomology by Geoffrey Lapage
9. Parasitology (Protozoology & Helminthology) K.D. Chatterjee
10. Parasitology by Elmer R. Nobel and Glenn A. Noble

(Value Added Course)

Course Code: **ZOO21106DCE**
Total Credits: **3** (3 L + 0 T + 0 P)

Course Title: **Veterinary Parasitology**
Maximum Marks: **75** (15+60)

Course objective: To impart knowledge about the parasites of veterinary importance viz., parasites of Fishes, Poultry, Ruminants like sheep, goat cattle etc.

Course outcome: The learner gain expertise in dealing with diseases of fish, poultry and ruminants. To assess the importance of prevalence and epidemiology of these diseases in domestic animals. Know how resistance development and resistance transfer occur. Understand the mechanisms for transmission, virulence and pathogenicity of the diseases. To diagnose the causative agents, suggest the prophylactic measures and treatment of important parasitic diseases.

Unit I: Protozoa (16 Hours)

Protozoan parasites of fishes with special reference to *Cryptobia* & *Myxosoma*; protozoan parasites of poultry with special reference to *Eimeria* & *Histomonas*; epidemiology, lifecycle, pathogenicity and control of *Toxoplasma* & *Sarcocystis* in sheep; epidemiology, lifecycle, pathogenicity and control of *Trichomonas* & *Babesia* in cattle

Unit II: Trematoda (16 Hours)

Trematode parasites of fishes with special reference to the morphology, biology and control of *Diplozoon* & *Clinostomum*; trematode parasites of aves with special reference to life cycle, pathogenicity and control of *Echinostomum* & *Trichobilharzia*; trematode parasites of ruminants with reference to the life cycle, pathogenicity and control of *Fasciola* & *Dicrocoelium*; general account of anthelmintics and anthelmintic resistance.

Unit III: Cestoda (16 Hours)

Cestode parasites of fishes with special reference to morphology, life cycle, pathogenicity and control of *Adenoscolex* & *Bothriocephalus*; cestode parasites of aves with special reference to life cycle, pathogenicity and control of *Davainea* & *Railletina*; cestode parasites of ruminants with special reference to life cycle, pathogenicity and control of *Moneizia* & *Stilesia*; diseases caused by larval cestodes in ruminants.

Suggested Books/Reading Material

1. Animal Parasitology by J. D. Smyth
2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
3. Foundations of Parasitology by Larry S. Roberts, John Janovy & Steve Nadler
4. General parasitology by Thomas C. Cheng
5. Georgis' Parasitology for Veterinarians 10th Edition Evolve Elsevier.
6. Helminthes Arthropods and Protozoa of Domesticated Animals by E.J.L. Soulsby
7. Introduction to Parasitology by A.S.A. Chandler & Clark P. Read
8. Monning's Veterinary Helminthology and Entomology by Geoffrerg Lapage
9. Parasitology and Vector Biology by William C. Marquardt, Richard S. Demaree & Robert B. Grieve
10. Parasitology by Elmer R. Nobel and Glenn A. Noble
11. Veterinary Parasites By G M Urquhart & J Armour Published by Blackwell Science

(Skill Development Course)

Course Code: **ZOO21107DCE**

Course Title: **Laboratory Course 02**

Total Credits: **2 (0 L + 0 T + 2 P)**

Maximum Marks: **50 (10+40)**

A. Field Survey: (10 Marks)

Visit to various local fish farms, poultry farms, sheep & cattle farms and different slaughter houses for demonstration & collection of faecal samples and parasites. Students are required to present a detailed report of the survey.

B. Practical's: (40 Marks)

Duration: **64 Hours**

List of Practicals:

1. Slide study of protozoan parasites of Man: *Entamoeba*, *Balantidium*, & *Leishmania*
2. Slide study of protozoan parasites/ oocysts of Ruminants: *Eimeria*, *Toxoplasma* & *Babesia*
3. Preparation of permanent mounts of parasitic protozoans
4. Slide study of Trematode parasites of Man: *Schistosoma*, *Paragonimus*, *Clonorchis*
5. Slide study of Trematode parasites of Ruminants: *Fasciola*, *Dicrocoelium*, *Paramphistomum*
6. Slide study of Cestode parasites of Man: *Taenia solium*, *Taenia saginata*, *Hymenolepis*
7. Slide study of Cestode parasites of Ruminants: *Moniezia* & *Stilesia*
8. Slide study of Nematode parasites of Man: *Enterobius* & *Ancylostoma*
9. Slide study of Cestode parasites of Ruminants: *Haemonchus* & *Trichuris*
10. Slide study of acanthocephalans
11. Slide study of arthropod vectors
12. Methods of collection, fixation and preservation of ecto and endoparasites from different hosts viz., fish, fowl, sheep and cattle
13. Methods of permanent mount preparation of ecto and endoparasites
14. Faecal, Blood and Urine Examinations for diagnosis of parasitic diseases
15. Microtomy -cryostat
16. Micrometry

Suggested Books / Reading Material

1. Manual of Practical Microbiology and Parasitology by Pal Chakraborty
2. Parasitology Easy to Learn by Chandra T Jaya, Jaypee Brothers Medical Publishers
3. Practical Exercises in Parasitology by D. W. Halton
4. Practical Guide to Diagnostic Parasitology by Lynne S. Garcia.

(Value Added Course)

Course Code: **ZOO2101GE**

Course Title: **Fundamentals of Wildlife**

Total Credits: **2 (2 L + 0 T + 0 P)**

Maximum Marks: **50**

Course objective: To sensitize the students about different aspects and issues of Wildlife at national and regional level

Course outcome: The students can utilize the knowledge in educating the people about the importance of wildlife and their role in conservation

Unit I: Wildlife-I

(16 Hours)

Wildlife: introduction, importance and conservation; amphibia: general account and parental care; reptilia: general account, biology of Indian crocodiles, identification of poisonous & non-poisonous snakes; birds and mammals: aquatic and terrestrial adaptations, bird migration.

Unit II: Wildlife-II

(16 Hours)

Biogeographical zones of India; human- wildlife conflict: causes, consequences and its management; status and distribution of hangul, markhor and snow leopard; conservation projects: crocodile, tiger and snow leopard.

Suggested Books / Reading Material

1. Ecology and Field Biology, Robert. L. Smith (1966) Harper & Row Publishers New York
2. Fundamentals of wildlife Management -2nd edition) Rajesh Gopal (2012) Natraj Publishers, Dehradun India
3. Handbook of Bird Biology by Irby J. Lovette and John W. Fitzpatrick
4. Herpetology: An Introductory Biology of Amphibians and Reptiles by Laurie J. Vitt
5. Indian mammals a field guide by Vivek Menon
6. Mammalogy by Nicholas J. Czaplewski, James M. Ryan, Terry A. Vaughan
7. Wilderness Wildlife G. A. Bhat (2008) Book Vision Hazratbal Srinagar
8. Wildlife Biology by Raymond F. Dasmann

(Skill Development Course)

Course Code: **ZOO2101OE**

Course Title: **Fish Farming**

Total Credits: **2 (2 L + 0 T+0 P)**

Maximum Marks: **50**

Course objective: The culture techniques of locally available fishes, air-breathing, brackish water fishes, prawn culture and idea bout integrated and composite fish culture.

Course outcome: The course will be helpful to students by making them aware about the farming of fishes, their feeding requirement and their management. The course will help the students to have an idea how fish can be cultured and reared.

Unit I: Culture Technique –I

(16 Hours)

Culture of air breathing fishes; brackish water fish culture; prawn culture; pearl culture.

Unit II: Culture Technique –II

(16 Hours)

Carp culture; trout culture; composite fish culture; integrated fish farming.

Suggested Books / Reading Material

1. A Text Book of Fish Biology & Fisheries by S.S. Khanna and H.R. Singh Narendra Publishing House
2. An Introduction to Fishes by H.S. Bhamrah, Kavita Juneja Anmol Publications Pvt Ltd
3. Aquaculture: Principles and Practices by TVR Pillay, Blackwell publications
4. Fish and Fisheries by B.N. Yadav Daya Publishing House
5. Fresh Water Fish Pond and Culture and Management by Chakroff M. Scientific Publishers,
6. Fundamentals of Ichthyology by S.P. Biswas
7. Textbook of Fish Culture- Breeding and Cultivation of Fish Huet, M. Fishing News (Books) Ltd.

**Choice Based Credit System (CBCS) Scheme for 2nd Semester
(Batch-2021 onwards)**

Course Code	Course Title	Course Type	Hours / Week			Credits	Examinations / Marks	
			L	T	P		Internal Assessment	Term End Examination
ZOO21201CR	Anatomy and Physiology of Mammals	Core	4	0	0	4	20 Marks	80 Marks
ZOO21202CR	Animal Behaviour and Developmental Biology	Core	4	0	0	4	20 Marks	80 Marks
ZOO21203CR	Wildlife Management	Core	2	0	0	2	10 Marks	40 Marks
ZOO21204CR	Laboratory Course 03	Core	0	0	8	4	20 Marks	80 Marks
ZOO21205DCE	Morphology, Anatomy and Physiology of Fishes	Discipline Centric	3	0	0	3	15 Marks	60 Marks
ZOO21206DCE	Aquaculture and Nutrition	Discipline Centric	3	0	0	3	15 Marks	60 Marks
ZOO21207DCE	Laboratory Course 04	Discipline Centric	0	0	4	2	10 Marks	40 Marks
ZOO2102GE	Laboratory Course 04	Generic Elective	2	0	0	2	10 Marks	50 Marks
ZOO2102OE	Parasitology in Relation to Public Health	Open Elective	2	0	0	2	10 Marks	50 Marks

GENERAL INSTRUCTIONS

- A candidate has to obtain **24 credits per semester** i.e., **96 credits in two-year** programme (4 semesters).
- Out of 24 credits in a semester, a candidate has to compulsorily obtain 14 credits from **“Core Courses” (CR)** while the remaining 10 credits can be obtained from the **“Electives”** in the following manner:
 - ▶ A candidate has to obtain 8 credits from his/her own Department as **Discipline Centric Electives (DCE)**.
 - ▶ 2 credits shall be obtained by a candidate from the Electives offered by the Departments other than his/her own. A candidate shall be free to obtain these 2 credits from the **Generic or Open Electives**.
 - ▶ A candidate has the option to opt for **MOOC's** in place of **GE/OE**.
- Maximum Marks per Credit are 25 (One unit is equivalent to one credit).
- One Credit in Theory is 16 hours direct teaching learning; where as in Practicals and Tutorials it is 32 hours.

Course No.: **ZOO21201CR**

Course Title: **Anatomy and Physiology of Mammals**

Total Credits: **4** (4 L + 0 T + 0 P)

Maximum Marks: **100** (20 + 80)

Course objective: To understand the structure and functional aspects of different organ systems in mammals especially digestive, circulatory, excretory & neuro-endocrine systems and sense organs.

Course outcome: The students shall utilise the knowledge in understanding the working of different organ systems of mammals and the mechanisms of disorders in these organ systems.

Unit I: Digestive & Respiratory System (16 Hours)

Structure of digestive system & associated glands; physiology of digestion, absorption and assimilation; structure of lungs, transport & exchange of respiratory gases & regulation of respiration; cell respiration: glycolysis, TCA cycle and etc.

Unit II: Circulatory & Excretory System (16 Hours)

Structure and function of heart; composition and function of blood, haemostasis; structure of kidney; physiology of excretion-urine formation, micturition, regulation of water balance.

Unit III: Neuro- Endocrine System (16 Hours)

Central nervous system: brain and spinal cord; peripheral nervous system: cranial and spinal nerves; structure, function, regulation and disorders of endocrine glands: pituitary, thyroid, parathyroid, pineal, thymus; structure, function, regulation and disorders of partly endocrine glands: pancreas, gonads, placenta.

Unit IV: Sense Organs and Receptors (16 Hours)

Receptors- general account; gustatory and olfactory receptors with their physiology; eye and physiology of vision; ear and physiology of hearing.

Suggested Books / Reading Material

1. Animal Physiology – Adaptation and Environment by Knut Schmidt Nielsen
2. Animal Physiology by Eckert & Randall
3. Animal Physiology by James Anderson
4. Comparative Physiology by B. T. Scheer
5. Essentials of anatomy and physiology by Seeley, Stephans and Tate
6. Essentials of Animal Physiology by S. C. Rastogi
7. General & Comparative Physiology by William S. Hoar
8. Textbook of Animal Physiology by R. Nagabhushanam

Course No.: **ZOO21202CR** Course Title: **Animal Behaviour and Developmental Biology**
Total Credits: **4** (4 L + 0 T + 0 P) Maximum Marks: **100** (20 + 80)

Course objective: To understand behavioural attributes and developmental aspects of animals

Course outcome: The students will utilize the knowledge in understanding various patterns of behaviour in a variety of taxa and different stages that occur in the development of animals

Unit I: Behaviour Development (16 Hours)

Home range, territoriality, dispersal, habitat selection; food selection and optimal foraging theory, criticisms of optimal foraging theory; genetic and environmental components in the development of behaviour; neural basis of behavior: stimulus filtering, biological rhythms.

Unit II: Social and Parental Behaviour (16 Hours)

Social organization in insects and primates; parental care and nesting habits in birds; parental care in mammals; communication in animals: auditory, visual, chemical and tactile.

Unit III: Reproductive and Learning Behaviour (16 Hours)

Courtship and mating systems; parental investment and reproductive strategies; learning behaviour in vertebrates; migration in insects; migration in mammals with special reference to aerial and aquatic mammals.

Unit IV: Developmental Biology (16 Hours)

Cleavage and formation of morula; formation and implantation of blastocyst; gastrulation in mammals; extra embryonic membranes— formation, structure and function; natural and artificial parthenogenesis; significance of parthenogenesis;

Suggested Books / Reading Material

1. An introduction to Animal Behaviour by Manning and Dawkins, Cambridge University Press
2. Animal Behaviour- an Evolutionary Approach by John Alcock Sinauer Associates, Inc Publishers Sunderland, Massachusetts
3. Animal Behaviour by Anbery
4. Animal Behaviour by M.P. Arora Himalaya Publishing House
5. Essential Animal Behavior by Graham Scott
6. Mechanism of Animal Behaviour by Peter Marker and J. Hamilton, Jhon Wiley & Sons USA
7. Principles and Animal Development by S.C. Goel

(Value Added Course)

Course No.: **ZOO21203CR**

Course Title: **Wildlife Management**

Total Credits: 2 (2 L + 0 T + 0 P)

Maximum Marks: **50** (10 + 40)

Course objective: To endow knowledge about management of threatened wildlife fauna at national and regional level

Course outcome: The students can work in various government and non government organizations and can act as leaders in animal conservation.

Unit-I: Wildlife Management I (16 Hours)

Introduction and importance of wildlife; protected area network in India; control and management of forest fire and soil erosion; human- wildlife conflict: causes, consequences and management.

Unit-II: Wildlife Management II (16 Hours)

Protected area network in j&k; conservation status of hangul, markhor and tibetan antelope; wetlands: introduction, types, threats and management; threatened fauna of jammu and kashmir.



Suggested Books / Reading Material

1. Fundamentals of Wildlife Management (2nd edition) by Rajesh Gopal Natraj Publishers, Dehradun India
2. Managing our Wildlife resources by S. A. Anderson
3. Wilderness Wildlife by G. A. Bhat, Book Vision Hazratbal Srinagar
4. Biodiversity of the Himalaya: Jammu and Kashmir State by G.H. Dar & Anzar A. Khuroo, Springer Nature Singapore Pte Ltd
5. Indian Mammals by Vivek Menon, Wildlife Trust of India

Course Code: **ZOO21204CR**
Total Credits: **4** (0 L + 0 T + 4 P)

Course Title: **Laboratory Course 03**
Maximum Marks: **100** (20 + 80)

A. Field Survey: (20 Marks)

One-week field study cum collection trip within the UT's of J&K and Ladakh. Each student/group of students shall have to submit the collection of specimens for the departmental museum along with survey report.

B. Practical's: (80 Marks)

Duration: 128 Hours

1. Study of histological slides – T. S. of Stomach, Intestine, Liver, and Lungs
2. Demonstration of enzyme action on starch
3. Determination of blood groups, bleeding time and estimation of haemoglobin
4. Determination of TLC & DLC, Total Erythrocyte Count (TEC) & ESR of human blood
5. Study of various organ systems through dissection of Rat
6. Study of skeletal elements of Rabbit
7. Study of various endocrine glands through prepared slides
8. Study of various organs of sheep – brain/ eye/ heart/ kidney
9. Study of various types of bird nests
10. Investigation of hydrotaxis, chemotaxis and phototaxis in earthworm
11. Study of gametogenesis through prepared slides
12. Study of invertebrate and vertebrate egg specimens (insects, fishes, frog and hen)
13. Study of preserved specimens of human fetus of three trimesters
14. Study of fetal membranes through prepared slides / charts
15. Identification and survey of museum specimens of Amphibia
16. Identification and survey of museum specimens of Reptilia
17. Identification and survey of museum specimens of Aves
18. Identification and survey of museum specimens of Mammalia
19. Field exercises to study various types of behaviour in animals

Suggested Books / Reading Material

1. A Manual of Practical Zoology by P. S. Verma
2. A laboratory manual and text-book of embryology. (1918) W.B. Saunders Company, Philadelphia and London.
3. A Textbook of Vertebrate Practical Zoology by Vivekan and Banerjee
4. Clinical Physiology y, Banerjee Ashis
5. Practical Zoology: Vertebrate (English, Rastogi Publications, S.S.Lal)

Course Code: **ZOO21205DCE** Course Title: **Morphology, Anatomy and Physiology of Fishes**
Total Credits: **3** (3 L + 0 T +0 P) (Maximum Marks: **75** (15 + 60))

Course objective: Classification and evolution of fishes, modification of various body structures, knowledge about the structure and function of various organs

Course outcome: The course will be helpful to students by providing in-depth knowledge to taxonomy of major groups of fishes, evolutionary history, their morphology, physiology and anatomy. Specifically, the students will become familiar with fish taxonomy and fish identification (especially regional freshwater fishes) and will be provided knowledge about local aquatic habitats besides the students will also know the anatomy and physiology of fishes their mode of feeding and digestion, respiration, circulation, excretion as well as sensory system.

Unit I: Systematics and Morphology (16 Hours)

Introduction to ichthyology; tools of fish classification; outline classification of fishes with distinguishing characters up to principal sub-divisions with special emphasis on berg's scheme; general account on adaptive radiation in elasmobranchii and actinopterygii; structure, types and modification of scales and fins.

Unit II: Fish Anatomy and Physiology-I (16 Hours)

Digestive system and physiology of digestion; structure and function of gills; structure and function of heart and blood vessels; structure and function of kidneys (excretion and osmoregulation).

Unit III: Fish Anatomy and Physiology-II (16 Hours)

Structure and function of nervous system (teleost); structure and function of endocrine organs; sense organs and their functions, lateral line and neuromast; reproductive organs in fishes (teleost).

Suggested Books / Reading Material

1. A Text Book of Fish Biology & Fisheries by S S Khanna and H R Singh Narendra Publishing House
2. An Introduction to Fishes by H.S. Bhamrah, Kavita Juneja, Anmol Publications Pvt. Ltd
3. An Introduction to Ichthyology by Peter B. Moyle, Joseph J., Cech Jr.
4. Fish and Fisheries by B.N. Yadav Daya Publishing House
5. Fish Physiology, Series I-XIV by Hoar and Randall Academic Press
6. Fundamentals of Ichthyology by S. P. Biswas
7. Ichthyology handbook by Kapoor, B. G., & Khanna, Springer Science
8. Talwar, P. K. (1991). Inland fishes of India and adjacent countries CRC Press.
9. The Physiology of Fishes by Evans
10. The Physiology of Fishes Vol. I & II by Brown.

(Value Added Course)

Course Code: **ZOO21206DCE**

Course Title: **Aquaculture and Nutrition**

Total Credits: **3** (3 Lecture + 0 T +0 P)

Maximum Marks: **75** (15 + 60)

Course objective: Basic knowledge about the aquaculture, construction of ponds and their management, Culture techniques of some commercially important organisms, basic knowledge about the feeds, formulation and feeding.

Course outcome: The course will give a theoretical basis and practical experience for understanding of the principles in aquatic food production especially important ones. Fish health management is one of the important sustainability goals for aquaculture industry. It will also cover introduction to various nutritional requirements for better growth and production and formulation of fish feed for aquaculture. This course will be helpful in generation of self-employment by rearing of fishes in backyard ponds on small as well as large scale.

Unit I: Aquaculture

(16 Hours)

Aquaculture: status and prospects, criteria and practices (types of farming systems); application of biotechnology in aquaculture; site selection, construction and management of fish ponds; induced breeding: hypophysation and use of different synthetic hormones, significance of induced breeding, wet and dry bundh technique for breeding of indian major carps; pathogenic (bacterial, viral and fungal) and other diseases in fishes.

Unit II: Culture Techniques

(16 Hours)

Trout and carp culture; brackish water fish culture; prawn culture: culture method of giant freshwater prawn- *Macrobrachium rosenbergii*; pearl culture technique with special emphasis on *Pinctada spp.*; composite fish culture and integrated fish farming.

Unit III: Fish Nutrition

(16 Hours)

Macronutrients: protein, amino acids, lipid and carbohydrate requirement of fishes; micronutrients: vitamins and mineral requirement and their deficiency signs; fish feed ingredients, antinutritional factors, proximate composition and formulation of fish feed; types of fish feed: moist, semi-moist, dry; use of probiotics in aquaculture.

Suggested Books / Reading Material

1. A Text Book of Fish Biology & Fisheries by S.S Khanna and H.R Singh.
2. Aquaculture by John E. Bardach
3. Fish and fisheries of India by Jhingran, V. G. (1975).
4. Fish diseases and disorders by Woo, P. T. & Leatherland, J. F.
5. Fish in Nutrition. Eirik Heen and Rudolf Kreuzer, Fish News Book Ltd. FAO 1962
6. Fish Nutrition & Feed Technology by S. Athithan N. Felix & N. Venkatasany
7. Fish Nutrition in Aquaculture. Y.S.Chandrasekhar Swatik Publication New Delhi
8. Aquaculture: principles and practices by Pillay, T. V. R. & Kutty, M. N.
9. Text Book of Fish Culture by Marcel Heut

(Value Added Course)

Course Code: **ZOO21207DCE**
Total Credits: **2** (0 L + 0 T + 2 P)

Course Title: **Laboratory Course 04**
Maximum Marks: **50** (10+40)

A. Field Survey: (10 Marks)

Visit to various local water bodies, fish hatcheries and aquaria for demonstration, study and collection of specimens. Students are required to present a detailed report of the survey.

B. Practical's: (40 Marks)

Duration: **64 Hours**

1. General survey of Elasmobranchi, Holocephali, Dipnoi and Teleostei
2. Study of morphometric and meristic characters of fish
3. Identification and classification of fishes of Jammu and Kashmir
4. Gut content analysis to study feeding habits of fish
5. Dissection of accessory respiratory organs in fishes (*Anabus / Clarias / Heteropneustes*)
6. Dissection of fish to study internal anatomy
7. To study different organs of fish through histological slides
8. Preparation of temporary and permanent slides of various organs of fishes Physico-chemical parameters of water viz., Temperature, pH, conductivity, transparency, Total alkalinity, Dissolved oxygen, Free CO₂
9. Study of fish scales and determination of age
10. Determination of fecundity in fishes (Carps and *Schizothorax*)
11. Study of different adaptations in hill stream fishes
12. Extraction of Weberian ossicles and otolith from fish
13. Study of the electric organs and their nervous innervations in Torpedo
14. Estimation of hemoglobin, hematocrit and TLC and DLC
15. Estimation of moisture and ash from fish and available feed ingredients
16. Estimation of protein and fat in fish and available feed ingredients
17. Estimation of fat in fish and available feed ingredients
18. Collection and preservation of local fauna.

Suggested Books / Reading Material

1. Fish and Fisheries of India by Jhingran, V. G. (1975).
2. Practical Manual on Fish Nutrition and Feed Technology by S. Vinodh M. Kannan, P. Ranchana
3. Practical Manual of Fish Biology by AK Jaiswar

(Value Added Course)

Course Code: **ZOO21002GE**
Total Credits: **2** (2 L + 0 T + 0 P)

Course Title: **Basic & Applied Entomology**
Maximum Marks: **50**

Course objective: To aware the students about the fundamentals of applied entomology

Course outcome: The imparted knowledge will be utilized for human welfare

Unit I: Basic Entomology

(16 Hours)

Gross external morphology of insects; mouthparts of cockroach; structure of insect antennae and its types; structure of insect leg and its modifications

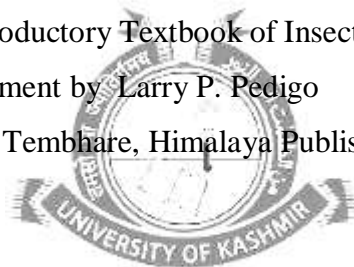
Unit II: Applied Entomology

(16 Hours)

Pheromones-types and uses; Insect resistance to chemical pesticides; IPM: concept, strategies and tools in pest management; Role of IPM in insect pest control.

Suggested Books / Reading Material

1. A text book of Applied Entomology-vol II by K.P. Shrivastava Kalyani Publishers
2. A text book of Applied Zoology by Pradip V. Jabde
3. Applied Entomology: An Introductory Textbook of Insects by Henry Torsey Fernald
4. Entomology and pest management by Larry P. Pedigo
5. Modern Entomology by D.B. Tembhare, Himalaya Publishing House



(Value Added Course)

Course Code: **ZOO21002OE**

Course Title: **Parasitology in relation to Public Health**

Total Credits: **2 (2 L + 0 T +0 P)**

Maximum Marks: **50**

Course objective: To aware the students about the nature of parasitic diseases their pathogenicity, mode of transmission and diagnosis of local parasitic diseases.

Course outcome: The knowledge will be utilized for the prevention/control of parasitic diseases

UNIT 1: Introduction to Parasitology (16 Hours)

Introduction to animal associations; distribution of parasites in animal kingdom; introduction to protozoa with special reference to protozoan parasites of man in Kashmir valley; description, life-cycle, pathogenicity and control of *Entamoeba histolytica* & *Giardia intestinalis*.

UNIT 2: Medical Helminthology (16 Hours)

Cestode parasites of man with reference to life-cycle, pathogenicity and control of *Taenia saginata*; trematode parasites of man with special reference to life-cycle, pathogenicity and control of *Schistosoma haematobium*; nematode parasite of man with special emphasis on description, life-cycle, pathogenicity and control of *Enterobius vermicularis*; life-cycle, pathogenicity and control of *Ascaris lumbricoides*.

Suggested Books / Reading Material

1. Animal Parasitology by J. D. Smyth
2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
3. Foundations of Parasitology by Larry S. Roberts, John Janovy and Steve Nadler
4. General parasitology by Thomas C. Cheng
5. Parasitology (Protozoology & Helminthology) by K. D. Chatterjee
6. Parasitology by Elmer R. Nobel and Glenn A. Noble

**Choice Based Credit System (CBCS) Scheme for 3rd Semester
(Batch-2021 onwards)**

Course Code	Course Title	Course Type	Hours / Week			Credits	Examinations / Marks	
			L	T	P		Internal Assessment	Term End Examination
Z0021301CR	Molecular Biology & Genetics	Core	4	0	0	4	20 Marks	80 Marks
Z0021302CR	Biostatistics & Biotechniques	Core	4	0	0	4	20 Marks	80 Marks
Z0021303CR	Veterinary and Agricultural Nematology	Core	2	0	0	2	10 Marks	40 Marks
Z0021304CR	Laboratory Course 05	Core	0	0	8	4	20 Marks	80 Marks
Z0021305DCE	Wildlife Biology, Conservation and Techniques	Discipline Centric	3	0	0	3	15 Marks	60 Marks
Z0021306DCE	Biogeography, Wildlife Ecology and Management	Discipline Centric	3	0	0	3	15 Marks	60 Marks
Z0021307DCE	Laboratory Course 06	Discipline Centric	0	0	4	2	10 Marks	40 Marks
Z002103GE	Basics of Aquaculture	Generic Elective	2	0	0	2	10 Marks	50 Marks
Z002103OE	Beneficial and Harmful Insects	Open Elective	2	0	0	2	10 Marks	50 Marks

GENERAL INSTRUCTIONS

1. A candidate has to obtain **24 credits per semester i.e., 96 credits in two-year** programme (4 semesters).
2. Out of 24 credits in a semester, a candidate has to compulsorily obtain 14 credits from “**Core Courses**” (CR) while the remaining 10 credits can be obtained from the “**Electives**” in the following manner:
 - ▶ A candidate has to obtain 8 credits from his/her own Department as **Discipline Centric Electives (DCE)**.
 - ▶ 2 credits shall be obtained by a candidate from the Electives offered by the Departments other than his/her own. A candidate shall be free to obtain these 2 credits from the **Generic or Open Electives**.
 - ▶ A candidate has the option to opt for MOOCs in place of **GE/OE**.
3. Maximum Marks per Credit are 25 (One unit is equivalent to one credit).
4. One Credit in Theory is 16 hours direct teaching learning; where as in practical's and Tutorials it is 32 hours.

Course No.: **ZOO21301CR**
Total Credits: **4(4L + 0 T + 0 P)**

Course Title: **Molecular Biology & Genetics**
Maximum Marks: **100 (20 + 80)**

Course objective: To understand principles of molecular biology and genetics

Course outcome: This knowledge will be utilized to elucidate disease mechanisms and biology along with the pedigree and knowledge of recombinant DNA technology. The students will be able to have an insight how rDNA technology is revolutionizing our modern world.

Unit I: Molecular Biology (16 Hours)

DNA structure and replication in prokaryotes and eukaryotes; DNA damage and repair; genetic code; transcriptional regulation in prokaryotes and eukaryotes; translation and post translational modifications in eukaryotes.

Unit II: Cell Regulation (16 Hours)

Signaling molecules and modes of cell-cell signaling; cell surface receptors; signal transduction pathways: MAP kinase and JAK/STAT pathways; apoptosis and cell renewal; cancer biology: cancer and its classes, transforming agents, cellular and viral oncogenes.

Unit III: Genetics (16 Hours)

Mendelian and non-mendelian inheritance; non-allelic gene interactions; sex determination and sex-linked characteristics; dosage compensation in mammals, drosophila and *c. elegans*; transposable elements; cytoplasmic inheritance.

Unit IV: Genomics (16 Hours)

Concept of genomics and human genome project, molecular markers: RFLP, AFLP; genetic polymorphism; gene mapping: linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids; human genetics: pedigree analysis, lod score for linkage testing, karyotyping, genetic disorders.

Suggested Books/Reading Material

1. Genes IX by Benjamin Lewin Jones and Bartlett Publishers
2. Genomes by Brown, T.A Garland Science Publishing, London, UK
3. Molecular Biology of Gene by Watson et al Pearson Education, Delhi, India
4. Molecular Biology of the Cell by Alberts et al. Garland Science
5. Molecular Cell Biology by Lodish et. al.
6. Principle of Genome Analysis and Genomics by Primrose, S.B. and Twyman R.M. Blackwell Publishing
7. Principles of Genetics by Gardner et al John Wiley
8. Science of Genetics by Atherlay
9. The Cell: A Molecular Approach by Cooper & Hausman, Sunderland publishers

(Value Added Course)

Course No.: **ZOO21302CR**

Course Title: **Biostatistics & Biotechniques**

Total Credits: **4(4 L + 0 T + 0 P)**

Maximum Marks: **100(20 + 80)**

Course objective: To understand the role of statistical methods and biological techniques in animal science

Course outcome: The knowledge can be utilized in experimentation and data analysis.

Unit I: Biostatistics

(16 Hours)

Methods of sampling; diagrammatic and graphic representation of data; measures of central tendency: mean, median and mode; measures of dispersion: standard deviation and standard error; probability and probability distribution: poisson, binomial, and normal distributions; tests of significance: chi square test, students t test and ANOVA (one way analysis).

Unit II: Microscopy & Morphometry

(16 Hours)

Techniques for the preparation of fixatives, preservatives and stains; light Microscopy; electron microscopy; SEM & TEM; micro-morphometry; spectroscopy: UV & visible.

Unit III: Biophysical and Molecular Techniques

(16 Hours)

Centrifugation and its applications; Electrophoresis and its applications; Blotting techniques and their applications; PCR: variants and applications.

Unit IV: Chromatography and Immunoassays

(16 Hours)

Ion exchange chromatography; gel-filtration chromatography; HPLC and GC; immunoassays: ELISA, radioimmunoassay and immunofluorimetry.

Suggested Books/Reading Material

1. An Introduction to Biostatistics by N. Gurumani
2. Biotechniques Theory and Practice by S. V. S. Rana, Rastogi publishers
3. Fundamentals of Biostatistics by Khan and Khanum, Ukaaz Publications
4. Principles and techniques of Biochemistry and Molecular Biology by Wilson and Walker

(Value Added Course)

Course No.: **ZOO21303CR**

Course Title: **Veterinary and Agricultural Nematology**

Total Credits: **2(2 L + 0 T + 0 P)**

Maximum Marks: **50(10 + 40)**

Course objective: To understand the nature & damage caused by nematode parasites in domestic animals and Plant parasitic nematodes in agricultural plants

Course outcome: The learner gain expertise in dealing with these parasites to check their population by breaking their life cycle and therefore minimise their damage and save the economy.

Unit I: Nematohelminths and Acanthocephala

(16 Hours)

Nematode parasites of fishes with special reference to life cycle, pathogenicity and control of *Rhabdochona guptii* and *Camallinus fottadarii*; nematode parasites of aves with special reference to life cycle, pathogenicity and control of *Heterakis gallinarum* and *Capillaria sp.*; nematode parasites of sheep with special reference to life cycle, pathogenicity and control of *Haemonchus contortus* and *Trichostrongylus sp.*; acanthocephalan parasites of fishes with special reference to *Pomphorhynchus kashmiriensis* and *Neo-echinorhynchus*.

Unit II: Agricultural Nematology

(16 Hours)

Introduction to plant parasitic nematodes with special reference to morphology, pathogenicity and control of *Meloidogyne* and *Heterodera*; general account on entomopathogenic nematodes; plant resistance to phytoparasitic nematodes; management and control of plant parasitic nematodes.

Suggested Books/ Reading Material

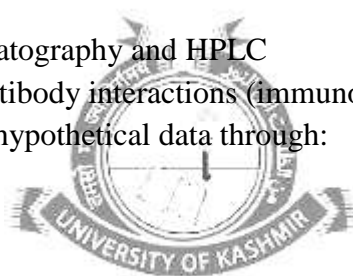
1. Animal Parasitology by J. D. Smyth
2. Parasitology (Protozoology & Helminthology) by K. D. Chatterjee
3. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
4. Plant Nematology by N.G. Ravichandra
5. Plant Nematology 2nd Edition by Roland N. Perry & Maurice Moens
6. Textbook of introductory plant nematology (revised 2nd edition). Raman K. Walia Harish K. Bajaj.

Course Code: **ZOO21304CR**
Total Credits: **4(0 L+ 0 T+4 P)**

Course Title: **Laboratory Course 05**
Maximum Marks: **100(20 + 80)**

List of Practicals: (128 H)

1. Preparation of temporary stained mount of the onion root for various mitotic stages
2. Preparation of temporary stained mount of the grasshopper testis for various meiotic stages
3. Slide study of various stages of mitotic and meiotic divisions
4. Study of Barr body through stained slides of squamous epithelial / neutrophil cells
5. Rearing of fruit fly and study of red and white character after crossing
6. Structure and working of different Microscopes
7. Preparation of Histological sections of vertebrate tissues viz., liver, gut, lungs
8. Localization of nucleic acids in tissue sections
9. Localization of proteins in tissue sections
10. PCR and gel electrophoresis
11. Demonstration of gel chromatography and HPLC
12. Demonstration of antigen antibody interactions (immunoassay)
13. Representation of collected/hypothetical data through:
 - i. Histogram
 - ii. Bar chart
 - iii. Pie charts
14. Statistical analysis on hypothetical data:
 - i. Chi square analysis
 - ii. Students t test
 - iii. ANOVA
15. Study of prepared slides/specimens of nematode and acanthocephalan parasites of animals
16. Collection, preservation and preparation of permanent mounts of nematode parasites collected from fishes, fowl and sheep gut
17. Methods of extraction of nematodes from soil
18. Isolation of DNA, Qualitative and quantitative analysis, PCR using suitable primers.



Suggested Books / Reading Material

1. A Manual of Practical Zoology by P. S. Verma
2. Biotechniques : Theory and Practice by S. V. S. Rana, Rastogi Publishers
3. Manual of Practical Microbiology and Parasitology by Pal Chakraborty
4. Practical Exercises in Parasitology by D. W. Halton
5. Practical Guide to Diagnostic Parasitology by Lynne S. Garcia.
6. Principles and techniques of Biochemistry and Molecular Biology by Wilson and Walker

(Value Added Course)

Course Code: **ZOO21305DCE** Course Title: **Wildlife Biology, Conservation and Techniques**

Total Credits: **3(3 L+ 0 T +0 P)**

Maximum Marks: **75(15 + 60)**

Course objective: To understand various aspects of biology of wildlife, conservation biology and application of techniques in wildlife study

Course outcome: The students can utilize the knowledge in framing conservation plans of wild fauna and their habitat.

Unit I: Wildlife Biology (16 Hours)

General account and parental care in amphibians; biology of crocodiles and lizards; adaptations in reptiles; migration in birds; important bird areas (IBAs) of Jammu & Kashmir; adaptations (aquatic and terrestrial) and thermoregulation in mammals.

Unit II: Wildlife Conservation (16 Hours)

In situ and ex situ conservation; keystone species: concept and its relevance for conservation IUCN red list categories and criteria; Conservation projects: tiger, hangul, snow leopard and musk deer.

Unit III: Wildlife Techniques (16 Hours)

Remote sensing and GIS: concept and applications in wildlife; methods of studying wildlife census capture of wildlife: live trapping, mist netting, chemical capture (equipments & tranquilizers); bird ringing and banding, use of radio transmitters in wildlife study.

Suggested Books/Reading Material

1. Conservation Biology. Richard B. Primack (2017). Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, U.S.A
2. Handbook of Bird Biology by Irby J. Lovette and John W. Fitzpatrick
3. Important Bird Areas of Jammu and Kashmir by A. R. Rahmani, Khurshid A., I. Suhail, P. Chandan and Ashfaq A. Zarri
4. Mammalogy by Nicholas J. Czaplewski, James M. Ryan, Terry A. Vaughan
5. Managing our Wildlife Resources by S. A. Anderson
6. Manual of Wildlife Techniques of India, Sale and Berkmuller. Wildlife Institute of India, Dehradun.
7. Remote Sensing and Image Interpretations, Lillesand, T.M.; Kiefer, R.W.; Chipman, J.W. (2004) John Wiley and Sons, Inc
8. Wildlife Biology by Raymond F. Dasmann

Course Code: **ZOO21306DCE** Course Title: **Biogeography, Wildlife Ecology & Management**
Total Credits: **3(3 L + 0 T+0 P)** Maximum Marks: **75 (15 + 60)**

Course objective: To provide knowledge on ecology and distribution of wild fauna

Course outcome: After completing the course the students can utilize the knowledge in understanding the distribution and aspects of ecology of fauna which is key to conservation and mapping.

Unit I: Biogeography (16 Hour)

Biogeographic realms of the world and their fauna; island biogeography; biological dispersal: mechanisms and barriers; biogeographical zones of India with reference to distribution of wild fauna.

Unit II: Wildlife Ecology (16 Hours)

Wildlife habitat types and their significance; major diseases of wild fauna (viral and bacterial); predation- concept, problems and principles; prey base of carnivores in wild habitat.

Unit III: Wildlife Resource Management (16 Hours)

Wildlife conservation strategies in India; wildlife protection act of India (1972), its brief structure and recent amendments; wildlife conventions: Ramsar, Bonn, CITES; national and international wildlife organizations: BNHS, WWF and IUCN

Suggested Books/Reading Material

1. Biogeography, Fourth Edition by Mark V. Lomolino, Brett R. Riddle, Robert J. Whittaker, James H. Brown (2010) Sinauer Associates, Inc.; Fourth edition
2. Zoogeography: The Geographic Distribution of Animals, Philip J. Darlington (1957)
3. Basics of Wildlife Health Care & Management, Rajesh Jani, Narendra Publishing House
4. An Introduction to Applied Biogeography by Spellerberg & Sawyer, Cambridge University Press
5. Wildlife Ecology & Management by Bolen and Robinson Printice Hall International (UK)
6. Animal Ecology and Distribution of Animals by Rastogi and Jayaraj
7. Managing our Wildlife Resources by S. A. Anderson
8. Fundamentals of Wildlife Management by Rajesh Gopal Natraj Publishers, Dehradun

(Value Added Course)

Course Code: **ZOO21307DCE**
Total Credits: **2** (0 L + 0 T+2 P)

Course Title: **Laboratory Course 06**
Maximum Marks: **50** (10+40)

A. Field Survey: (10 Marks)

1. Visit to important wildlife habitats of J & K to study different habitat aspects and to identify the animals in the field. Students are required to present a detailed report of the survey.

B. Practical's: (40 Marks)

Duration: **64 Hours**

1. Methods for studying behaviour of wild animals in the field
2. Monitoring of wild animals and demonstration of Census methods in the field
3. Operation of GPS, range finder, field binoculars and digital camera
4. Mapping distribution of primates, carnivores and ungulates
5. Study and preparation of pugs and hooves of wild animals in the field
6. Study of vegetation by quadrat method to determine frequency, density, abundance and distribution pattern
7. Reference slide preparation of hair samples of different wild and domestic mammals
8. Diet analysis of wild carnivores through scat analysis
9. Diet analysis of wild herbivores through pellet analysis
10. Examination of faecal matter of wild animals for helminth infection
11. Ecological distribution of some birds and mammals
12. Comparative study of structural adaptations of some mammals, birds, reptiles and amphibians
13. Comparative studies of dentition and skull of different mammals
14. Identification of poisonous and non-poisonous snakes
15. Examination and drawing of museum materials: beaks, claws, feathers and nests of characteristic species

Suggested Books / Reading Material

1. A Manual of Practical Zoology by P. S. Verma
2. A Textbook of Vertebrate Practical Zoology by Vivekanand Banerjee
3. Handbook of Bird Biology by Irby J. Lovette and John W. Fitzpatrick
4. Manual of Wildlife Techniques of India, Sale & Berkmuller. Wildlife Institute of India, Dehradun.
5. Practical Zoology: Vertebrate (English, Rastogi Publications, S.S.Lal)
6. Remote Sensing and Image Interpretations, Lillesand, T.M.; Kiefer, R.W.; Chipman, J.W. (2004) John Wiley and Sons, Inc

(Skill Development Course)

Course Code: **ZOO2103GE**

Course Title: **Basics of Aquaculture**

Total Credits: **2 (2 L+ 0 T + 0 P)**

Maximum Marks: **50**

Course objective: To provide basic knowledge about the aquaculture its types and practices, pond construction, technique of induced breeding and the selection, biochemical composition and formulation of fish feed

Course outcome: The course will give a theoretical and practical experience for understanding of the principles in aquatic food production. It will also cover introduction to various nutritional requirements for better growth and production and formulation of fish feed for aquaculture. This course will be helpful in generation of self-employment by rearing of fishes in backyard ponds on small as well as large scale.

Unit I: Aquaculture

(16 Hours)

Aquaculture criteria and practices; site selection, construction and management of fish pond; induced breeding and its significance in aquaculture; procurement of stocking material for aquaculture.

Unit II: Fish Nutrition

(16 Hours)

Food and feeding habits of fish; types of fish feed; classification of fish feed ingredients; fish feed formulation; protein and carbohydrate requirement in fishes; vitamin and mineral requirement in fishes.

Suggested Books / Reading Material

1. An Introduction to Fishes by H.S. Bhamrah, Kavita Juneja Anmol Publications Pvt Ltd
2. Aquaculture: Principles and Practices by TVR Pillay, Blackwell publications
3. Fish and Fisheries by B.N. Yadav Daya Publishing House
4. Fish and Fisheries by B.N. Yadav Daya Publishing House
5. Fresh Water Fish Pond and Culture and Management by Chakroff M. Scientific Publishers,
6. Fundamentals of Ichthyology by S.P. Biswas
7. Textbook of Fish Culture- Breeding and Cultivation of Fish Huet, M. Fishing News (Books) Ltd.

(Skill Development Course)

Course Code: **ZOO2103OE**

Course Title: **Beneficial and Harmful Insects**

Total Credits: 2 (2 L + 0 T + 0 P)

Maximum Marks: **50**

Course objective: To understand the role of insects in day-to-day life

Course outcome: The learner can deal with beneficial and harmful insects

Unit I: Beneficial Insects

(16 Hours)

Insects in agriculture: pollinators and bio-control agents; insects in industry: apiculture, sericulture, lac culture.

Unit II: Harmful Insects

(16 Hours)

Insect as vectors of human diseases-general account; disease causing insects-myiasis; general account of polyphagous pests- cutworm and aphids; insect pests of vegetables (brassicas) with emphasis on life cycle and control of any one major pest.

Suggested Books / Reading Material

1. A text book of Applied Entomology –vol. II by K.P. Srivastava Kalyani Publishers
2. A text book of Applied Zoology by Pradip V. Jabde
3. Modern Entomology by D. B. Tembhare Himalaya Publishing House

Choice Based Credit System (CBCS) Scheme for 4th Semester (Batch-2021 onwards)

Course Code	Course Title	Course Type	Hours / Week			Credits	Examinations / Marks	
			L	T	P		Internal Assessment	Term End Examination
ZOO21401CR	Ecology, Limnology & Biodiversity	Core	4	0	0	4	20 Marks	80 Marks
ZOO21402CR	Immunology & Applied Zoology	Core	4	0	0	4	20 Marks	80 Marks
ZOO21403CR	Fish Biology and Processing Technology	Core	2	0	0	2	10 Marks	40 Marks
ZOO21404CR	Laboratory Course 07 (Dissertation)	Core	0	0	8	4	20 Marks	80 Marks
ZOO21405DCE	Insect Morphology, Classification and Ecology	Discipline Centric	3	0	0	3	15 Marks	60 Marks
ZOO21406DCE	Economic Entomology and Pest Management	Discipline Centric	3	0	0	3	15 Marks	60 Marks
ZOO21407DCE	Lab Course 08	Discipline Centric	0	0	4	2	10 Marks	40 Marks
ZOO21004GE	Fundamentals of Immunology	Generic Elective	2	0	0	2	10 Marks	40 Marks
ZOO21004OE	Introduction to Wildlife Studies	Open Elective	2	0	0	2	10 Marks	40 Marks

GENERAL INSTRUCTIONS

- A candidate has to obtain **24 credits per semester** i.e., **96 credits in two-year** programme (4 semesters).
- Out of 24 credits in a semester, a candidate has to compulsorily obtain 14 credits from “**Core Courses**” (CR) while the remaining 10 credits can be obtained from the “**Electives**” in the following manner:
 - ▶ A candidate has to obtain 8 credits from his/her own Department as **Discipline Centric Electives (DCE)**.
 - ▶ 2 credits shall be obtained by a candidate from the Electives offered by the Departments other than his/her own. A candidate shall be free to obtain these 2 credits from the **Generic or Open Electives**.
 - ▶ A candidate has the option to opt for **MOOCs** in place of **GE/OE**.
- Maximum Marks per Credit are 25 (One unit is equivalent to one credit).
- One Credit in Theory is 16 hours direct teaching learning; where as in Practical's and Tutorials it is 32 hours.

(Value Added Course)

Course No.: **ZOO21401CR**

Course Title: **Ecology, Limnology & Biodiversity**

Total Credits: **4 (4 L + 0 T + 0 P)**

Maximum Marks: **100 (20+80)**

Course objective: To understand structure and function of different ecosystems

Course outcome: The knowledge will be utilized in conservation and sustainable exploitation of ecosystems

Unit I: Ecosystem Ecology

(16 Hours)

Ecosystem: structure and function, energy flow and mineral cycling (CNP); structure and function of forest and fresh water ecosystems; habitat and niche: concept of habitat and niche, niche width and overlap, fundamental and realized niche; ecological succession: types, mechanisms, changes involved in succession, concept of climax community; bioremediation; biomagnification; biomonitoring.

Unit II: Population Ecology

(16 Hours)

Attributes of population: natality, mortality, immigration, emigration, life tables, survivorship curves and net reproductive rate; population growth– exponential and logistic growth patterns, growth models- (time lag models); lotka–volterra model and leslie matrix model; life history strategies: r and k selection, clutch size and sex ratio; population regulation– extrinsic and intrinsic factors.

Unit III: Limnology

(16 Hours)

Physicochemical parameters of water bodies (temperature, pH, dissolved oxygen, total alkalinity, turbidity and total dissolved solids); thermal stratification and its modifications; role of macro and micro-nutrients in water bodies; eutrophication in lakes, its causes and consequences.

Unit IV: Biodiversity

(16 Hours)

Biodiversity: concept, levels and values; biodiversity hotspots; loss of biodiversity; convention on biological diversity (CBD): objectives, priorities and action plan; biological diversity Act, 2002: main provisions and rules.

Suggested Books / Reading Material

1. Animal Ecology and Environmental Biology by PD Sharma
2. Ecology and Field Biology by Smith RL
3. Ecology by Chapman and Reiss
4. Ecology by Molles
5. Limnology by Welch PS
6. An Advanced textbook on Biodiversity by Krishnamurthy.
7. Limnology: Lake and River Ecosystems by Wetzel RG

8. Textbook of Limnology by Cole GA



(Value Added Course)

Course No.: **ZOO21402CR**

Course Title: **Immunology & Applied Zoology**

Total Credits: **4** (4 L + 0 T + 0 P)

Maximum Marks: **100** (20 + 80)

Course objective: To understand the principles of immunology and applied zoology

Course outcome: The students shall utilise the knowledge in understanding the immune responses and disorders of immune systems, gene cloning, sequencing and gene mapping in addition techniques that revolutionized the pharmaceutical, health and agricultural industries.

Unit I: Defense Mechanism in Higher Vertebrates

(16 Hours)

Innate immunity and acquired immunity; complement system: classical & properdin pathways; immuno-deficiency diseases: stem cell, B & T-cell deficiency diseases; tumour immunology with special emphasis on tumour immunotherapy (MAb's)

Unit II: Damaging and Defective Immune Response

(16 Hours)

Concept of hypersensitivity, classification of hypersensitivity reactions; mechanism of type I and type II hypersensitivity reactions; general account on autoimmune diseases with special emphasis on auto-immune anemia's & rheumatoid arthritis; transplantation immunology-homograft rejection.

Unit III: Animal Biotechnology

(16 Hours)

Production & contribution of transgenic animals to human welfare (Poultry & Dairy); modern assisted reproductive techniques for the improvement of cattle; application of biotechnology in – (a) sericulture, (b) apiculture; rDNA technology for production of useful molecules.

Unit IV: Animal Cell Culture and Gene Therapy

(16 Hours)

Cell culture media; cell culture types & techniques; sterilization techniques; gene therapy: ex-vivo & in-vivo; target human diseases & tissues of choice for gene therapy.

Suggested Books / Reading Material

1. Basic Immunology by Sharon, J. William and Wilkins
2. Biotechnology and Genomic by P. K. Gupta
3. Immunology by F. M. Burnet
4. Immunology by Kubly Goldsby, R., Kindt, T.J. and Osbourne, B.A., W.H. Freeman
5. Immunology by P. M. Lydyard, A. Whelan And M. W. Fanger
6. Immunology by Roitt, I.M., Brostoff, J. and Male, D. Mosby
7. Immunology: An Introduction by Ian R Tizard
8. Medical Immunology for Students by Playfair, J.H.L. and Lydyard, P.M. Churchill

(Skill Development Course)

Course No.: **ZOO21403CR**

Course Title: **Fish Biology and Processing Technology**

Total Credits: **2 (2 L + 0 T + 0 P)**

Maximum Marks: **50 (10 + 40)**

Course objective: Population and growth studies, Study of adaptive strategies, Basic knowledge about the migration of important fishes, Knowledge of the biochemical composition and preservation of fishes

Course outcome: The main outcome of the fish biology study is that it will help the students to have the knowledge of population estimation, age and growth for conservation and sustainable growth of fishes. On the other hand, knowledge about the biochemical composition and processing of fish will be helpful in reducing the loss by spoilage. Processing is considered as a branch of food science, where a set of methods and techniques are used to transform raw ingredients into food for safe consumption by humans or animals.

Unit I: Fish Biology

(16 Hours)

Population estimation, structure and dynamics; Fecundity: absolute and relative; Age determination: Length frequency analysis, model progression methods, growth check, scale and otoliths; Adaptations in hill stream, deep sea and cave fishes; Fish migration and its types.

Unit II: Fish Biochemical Composition and Processing

(16 Hours)

Biochemical composition of fish: Protein, carbohydrates, fats, vitamins and minerals; Factors affecting the seasonal variation in biochemical composition of fish; Methods used for preservation and processing of fish; Fish by-products.

Suggested Books / Reading Material

1. A Text Book of Fish Biology & Fisheries by S S Khanna and H R Singh Narendra Publishing House
2. An Introduction to Fishes by H.S. Bhamrah, Kavita Juneja Anmol Publications Pvt Ltd
3. Fish and Fisheries by B.N. Yadav Daya Publishing House
4. Fish and Fisheries by Pandey and Shukla
5. Fish and Fisheries of India by Jhingran
6. Fundamentals of Ichthyology by S.P. Biswas

(Skill Development Course)

Course Code: **ZOO21404CR**

Course Title: **Laboratory Course 07 (Dissertation)**

Total Credits: **4** (0 L + 0 T + 4 P)

Maximum Marks: **100** (20 + 40 + 40)

- I.** The students shall be allotted a mini project in M. Sc. 3rd Semester by a mentor to whom he/she shall be assigned. The students shall start the project work right from 3rd semester and by the time they reach 4th semester, they shall have to complete the same and submit the processed collection for the Museum and a report for the perusal of the examiners

(Internal & External). A brief outline of the projects in different specializations is as under:

- a. Parasitology**
- b. Ichthyology**
- c. Entomology**
- d. Wildlife**

- II.** The students are provided an opportunity to visit various places within and outside the valley for fauna collection. All students are required to submit the collected specimens, duly identified, labeled and accompanied with a detailed account.

Course Code: **ZOO21405DCE** Course Title: **Insect Morphology, Classification and Ecology**
Total Credits: **3** (3 L+ 0 T+0 P) Maximum Marks: **75** (15 + 60)

Course objective: To impart knowledge about the morphology, classification and ecology of insects.
Course outcome: The learner can utilize the knowledge to identify insects in general and beneficial and harmful insects in particular. Besides, the learner can forecast the incidence of agriculturally important insects.

Unit I: Insect Morphology (16 Hours)

Integument– structure and composition; head– structure and appendages (mouth parts and antennae); thorax– structure and appendages; abdomen and its modifications

Unit II: Insect Classification (16 Hours)

Basis of insect classification; outline classification of apterygota with important orders and families- Protura, Collembola, Diplura and Thysanura; Classification of Pterygota with economically important orders and families- Orthoptera, Hemiptera, Isoptera, Diptera, Coleoptera, Lepidoptera, and Hymenoptera,

Unit III: Insect Ecology (16 Hours)

Effects of high-altitude environment on morphology, physiology and development of insects; effects of temperature, humidity and light on the activities of insects; population dynamics; insect-plant interactions.

Suggested Books / Reading Material

1. Entomology by Cedric Gillott Plenum Press, New York
2. Fundamentals of Entomology by Richard J. Elizinga
3. Imm's General Text Book of Entomology vol. I & II by O. W. Richards and R.G. Davis Springer
4. Introduction to Entomology by Comstock
5. Modern Entomology by D. B. Tembhare, Himalaya Publishing House
6. Physiological Systems in Insects by Marc J. Klowden Academic Press
7. The Insects: Structure and Function by R.F. Chapman Cambridge University Press

(Value Added Course)

Course Code: **ZOO21406DC** Course Title: **Economic Entomology & Insect Pest Management**
Total Credits: **3** (3 L+ 0 T +0 P) Maximum Marks: **75** (15 + 60)

Course objective: To study insect pests of agriculture and horticultural crops along with their management strategies

Course outcome: The learner can utilize the knowledge in establishing insect pest consultancies

Unit I: Agricultural and horticultural Entomology (16 Hours)

General account of polyphagous insect pests with emphasis on the occurrence, economic importance, life cycle and control of cutworm and white grubs; insect pests of temperate fruits with emphasis on the occurrence, economic importance, life cycle and control of major pests; insect pests of paddy, wheat and maize with emphasis on the occurrence, economic importance, life cycle and control of major pests; insect pests of brassicaceous vegetables with emphasis on the occurrence, economic importance, life cycle and control of major pests.

Unit II: Medical and veterinary entomology (16 Hours)

General account of insects as vectors of human diseases; insect borne bacterial and protozoan diseases of man; myiasis causing insects in humans and domestic animals; life cycle and control measures of *Cochliomyia hominivorax* and *Hypoderma lineatum*.

Unit III: Insect Pest Management (16 Hours)

Cultural control of insects– principles, methods and techniques with examples; chemical insecticides–organochlorines and organophosphates; biological control with successful examples of parasitoids and predators; IPM: concept, strategies and tools in pest management.

Suggested Books / Reading Material

1. A text book of Applied Zoology by Pradip V. Jabde
2. A text book of Applied Entomology –vol. II by K.P. Srivastava Kalyani Publishers
3. Entomology by Cedric Gillott Plenum Press, New York
4. Fundamentals of Entomology by Richard J. Elizinga
5. Introduction to Entomology by Comstock
6. Modern Entomology by D. B. Tembhare Himalaya Publishing House



Course Code: **ZOO21407DCE**
Total Credits: **2 (0 L + 0 T + 2 P)**

Course Title: **Laboratory Course 08**
Maximum Marks: **50 (10+40)**

A. Field Survey: (10 Marks)

1. Visit to various local agricultural and horticultural fields etc., for demonstration & collection of insects of economic importance and their preservation. Students are required to present a detailed report of the survey.

B. Practical's: (40 Marks)

Duration: **64 Hours**

1. Specimen study of Apterygota, Orthoptera, Isoptera, Hemiptera, Lepidoptera, Diptera, Coleoptera and Hymenoptera.
2. Permanent mount preparation of aphids, sucking lice, mosquitoes.
3. Minor dissection/temporary mount preparation of head, mouthparts, antennae, wings, legs, and genitalia of grasshopper/cricket/ cockroach/housefly/mosquito.

Suggested Books / Reading Material

1. A Manual of Practical Zoology by P.S. Verma
2. A Manual of Practical Entomology by M.M. Trigunayat

Course Code: **ZOO21004GE**

Course Title: **Fundamentals of Immunology**

Total Credits: **2 (2 L+ 0 T + 0 P)**

Maximum Marks: **50**

Course objective: To aware students about defense mechanism in higher vertebrates, defective immune responses like hypersensitivity, autoimmune diseases and graft-rejection

Course outcome: To utilize the knowledge for making immune system strong & taking prophylactic measures when suffering from different allergic and autoimmune diseases.

Unit I: Immunology I

(16 Hours)

Introduction to immunity: innate immunity: phagocytosis & inflammation; acquired immunity: cell mediated & humoral; types of acquired immunity; introduction to complement system.

Unit II: Immunology II

(16 Hours)

Hypersensitivity reactions, types & mechanism of allergic reactions; autoimmune diseases: autoimmune anaemia & rheumatoid arthritis; transplantation immunology: mechanism of homograft rejection; tumour immunology & tumour immunotherapy.

Suggested Books / Reading Material

1. Immunology by Kuby, J., Goldsby, R., Kindt, T.J. and Osbourne, B.A., W.H. Freeman
2. Medical Immunology for Students by Playfair, J.H.L. and Lydyard, P.M. Churchill
3. Immunology by Roitt, I.M., Brostoff, J. and Male, D. Mosby
4. Basic Immunology by Sharon, J. William and Wilkins
5. Immunology by P. M. Lydyard, A. Whelan and M. W. Fanger
6. Immunology by F. M. Burnet
7. Immunology: An Introduction by Ian R Tizard.

(Value Added Course)

Course Code: **ZOO21004OE**

Course Title: **Introduction to Wildlife Studies**

Total Credits: **2 (2 L+ 0 T + 0 P)**

Maximum Marks: **50**

Course objective: To acquaint the students with basic information on various aspects and issues of wildlife

Course outcome: The students can utilize the knowledge for launching awareness programs among local masses.

Unit I: Wildlife of India

(16 Hours)

Wildlife: Introduction and importance; types of protected areas in India; threats to wildlife habitats of India; wildlife protection act (1972), its brief structure and recent amendments

Unit II: Wildlife of J & K

(16 Hours)

Wildlife of Jammu & Kashmir- an overview; protected area network in J & K; threatened fauna of J & K; wetlands: introduction and importance

Suggested Books / Reading Material

1. Fundamentals of wildlife Management -2nd edition) Rajesh Gopal (2012) Natraj Publishers, Dehradun India
2. Wilderness Wildlife G.A. Bhat (2008) Book Vision Hazratbal Srinagar
3. Wildlife in India, V.B. Saharia (1982) Natraj Publishers Dehradun