

Scheme for Five Year Integrated B. Sc., M. Sc. programme in Zoology under CBCS

Semester- 1

	Code	Title of the Course	Credits
CORE	ZOO-CC-101	Animal Diversity (Non-Chordates)	04
	ZOO-CC-102	Cell Biology	04
	ZOO-CC-103	Lab. Course based on CC-101 & CC-102	02
	ZOO-CC-104	Fundamentals of Biochemistry	04
	ZOO-CC-105	Lab. Course of Biochemistry	02
DSE	NIL		
GE	Any one from the following combinations		
	ZOO-GE-101	Chemistry: Inorganic Chemistry-I	04
	ZOO-GE-102	Lab. Course Chemistry	02
	OR		
	ZOO-GE-103	Botany: Biodiversity (Microbes, Algae, Fungi & Archegoniate)	04
	ZOO-GE-104	Lab. Course Chemistry	02
AEC	ZOO- AEC-101	Functional English/	02
	ZOO-AEC-102	Urdu/	
	ZOO-AEC-103	Arabic/	
	ZOO-AEC-104	Hindi	
Total credits:			24

For four credit courses marks shall be divided as follows:

CIA: 40

ESE: 60

For Two credit course marks shall be divided as follows:

CIA: 20

ESE: 30

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Semester- I1

	Code	Title of the Course	Credits
CORE	ZOO-CC-201	Animal Diversity (Chordates)	04
	ZOO-CC-202	Genetics	04
	ZOO-CC-203	Lab. Course based on CC-201 & CC-202	02
	ZOO-CC-204	Animal Physiology	04
	ZOO-CC-205	Lab. Course of Animal Physiology	02
DSE	NIL		
GE	Any one from the following combinations		
	ZOO- GE-201	Chemistry: Organic Chemistry-I	04
	ZOO- GE-202	Lab. Chemistry	02
	OR		
	ZOO-GE-203	Botany: Plant Ecology and Taxonomy	04
	ZOO-GE-204	Lab. Botany	02
AEC	ZOO-AEC-201	Environmental Science	02
SEC	NIL		
Total credits:			24

For four credit courses marks shall be divided as follows:

CIA: 40 **ESE: 60**

For Two credit course marks shall be divided as follows:

CIA: 20 **ESE: 30**

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Semester- II1

	Code	Title of the Course	Credits
CORE	ZOO-CC-301	Systematics & Evolution	04
	ZOO-CC-302	Parasitology & Entomology	04
	ZOO-CC-303	Lab. Course based on CC-301 & CC-302	02
	ZOO-CC-304	Molecular Biology	04
	ZOO-CC-305	Lab. Course of Molecular Biology	02
DSE	NIL		
GE	Any one from the following combinations		
	ZOO- GE-301	Chemistry: Physical Chemistry-I	04
	ZOO-GE-302	Lab. Chemistry	02
	OR		
	ZOO-GE-303	Botany: Anatomy of Angiosperms	04
	ZOO-GE-304	Lab. Botany	02
AEC	NIL		
SEC	ZOO-SEC-301	Mathematics and Statistics for Biologist	02
	OR		
	ZOO-SEC-302	Organic Farming	
Total credits:			24

For four credit courses marks shall be divided as follows:

CIA: 40 ESE: 60

For Two credit course marks shall be divided as follows:

CIA: 20 ESE: 30

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Semester- IV

	Code	Title of the Course	Credits
CORE	ZOO-CC-401	Comparative anatomy of vertebrates	04
	ZOO-CC-402	Applied Zoology	04
	ZOO-CC-403	Lab. Course based on CC-401 & CC-402	02
	ZOO-CC-404	Immunology	04
	ZOO-CC-405	Lab. Course of Immunology	02
DSE	NIL		
GE	Any one from the following combinations		
	ZOO- GE-401	Chemistry: Inorganic Chemistry-II	04
	ZOO- GE-402	Lab. Chemistry	02
	OR		
	ZOO-GE-403	Botany: Economic Botany	04
	ZOO-GE-404	Lab. Botany	02
AEC	NIL		
SEC	ZOO-SEC-401	IT Skills	02
	OR		
	ZOO-SEC-402	Public Health and Hygiene	
Total credits:			24

For four credit courses marks shall be divided as follows:

CIA: 40 ESE: 60

For Two credit course marks shall be divided as follows:

CIA: 20 ESE: 30

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Semester- V

	Code	Title of the Course	Credits
CORE	ZOO-CC-501	Animal Ecology	04
	ZOO-CC-502	Wildlife Management & Conservation	04
	ZOO-CC-503	Lab. Course based on CC-501 & CC-502	02
	ZOO-CC-504	Biotechniques	04
	ZOO-CC-505	Lab. Course of Biotechniques	02
DSE	NIL		
GE	Any one from the following combinations		
	ZOO- GE-501	Chemistry: Organic Chemistry-II	04
	ZOO- GE-502	Lab. Course Chemistry	02
	OR		
	ZOO-GE-503	Botany: Plant Physiology & Reproductive biology	04
	ZOO-GE-504	Lab. Course Botany	02
AEC	NIL		
SEC	ZOO-SEC-501	Personality & Entrepreneurship development	02
	OR		
	ZOO-SEC-502	Sericulture	
Total credits:			24

For four credit courses marks shall be divided as follows:

CIA: 40

ESE: 60

For Two credit course marks shall be divided as follows

CIA: 20

ESE: 30

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Semester- VI

	Code	Title of the Course	Credits
CORE	ZOO-CC-601	Reproductive & Developmental Biology	04
DSE	ZOO-DSE-601	Pisciculture	02
	ZOO-DSE-602	Dairy Farming	02
	ZOO-DSE-603	Poultry Farming	02
	ZOO-DSE-604	Agro-Chemicals and Pest Management	02
	ZOO-DSE-605	Biostatistics	02
	ZOO-DSE-606	Recombinant DNA Technology	02
GE	Any one from the following combinations		
	ZOO- GE-601	Chemistry: Physical Chemistry-II	04
	ZOO -GE-602	Lab. Chemistry	02
	OR		
	ZOO-GE-603	Botany: Plant Biotechnology & Conservation	04
	ZOO-GE-604	Lab. course Botany	02
	Any one from the following		
SEC	ZOO-SEC-601	Herbal Medicine	02
	ZOO-SEC-602	Apiculture	
	ZOO-SEC-603	Aquaculture	
Total credits:			24

For four credit courses marks shall be divided as follows:

CIA: 40

ESE: 60

For Two credit course marks shall be divided as follows:

CIA: 20

ESE: 30

Total credits for B. Sc.= 144

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Semester- VII

	Code	Title of the Course	Credits
CORE	ZOO-CC-701	Biosystematics	4
	ZOO-CC-702	Animal, Structures & Functions	4
	ZOO-CC-703	Animal Behaviour	4
	ZOO-CC-704	(Lab. Course)	4
<u>Anyone from the following Combinations</u>			
DSE	ZOO-DSE-701	General Entomology	2
	ZOO-DSE-702	(Lab. Course)	2
	ZOO-DSE-703	General Parasitology	2
	ZOO-DSE-704	(Lab. Course)	2
	ZOO-DSE-705	Fish Classification and Structure	2
	ZOO-DSE-706	(Lab. Course)	2
<u>For the Students of other Departments</u>			
OGE	ZOO-OGE-701	Nutrition and Health	4
Total Credits:			24

For Four Credit Courses Marks shall be divided as follows:

CIA: 40

ESE: 60

For Two Credit Course Marks shall be divided as follows:

CIA: 20

ESE: 30

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Semester- VIII

	Code	Title of the Course	Credits
CORE	ZOO-CC-801	Inheritance Biology	4
	ZOO-CC-802	Evolutionary Biology	4
	ZOO-CC-803	Advanced Developmental Biology	4
	ZOO-CC-804	(Lab. Course)	4

Anyone from the Following Combinations

DSE	ZOO-DSE-801	Insect Ecology, Anatomy & Physiology	2
	ZOO-DSE-802	(Lab. Course)	2
	ZOO-DSE-803	Plant Nematology and Parasitic Resistance	2
	ZOO-DSE-804	(Lab. Course)	2
	ZOO-DSE-805	Fish Physiology and Ecology	2
	ZOO-DSE-806	(Lab. Course)	2

For the Students of other Departments

OGE	ZOO-OGE-801	Ornamental Fisheries	4
Total Credits:			24

For Four Credit Courses Marks shall be divided as follows:

CIA: 40 **ESE: 60**

For Two Credit Course Marks shall be divided as follows:

CIA: 20 **ESE: 30**

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Semester- IX

	Code	Title of the Course	Credits
CORE	ZOO-CC-901	Population Ecology/Limnology	4
	ZOO-CC-902	Environmental & Conservation Biology	4
	ZOO-CC-903	Vertebrate Endocrinology	4
	ZOO-CC-904	(Lab. Course)	4

Anyone from the Following Combinations

DSE	ZOO-DSE-901	Agricultural Pests/Medical & Veterinary Entomology	2
	ZOO-DSE-902	(Lab. Course)	2
	ZOO-DSE-903	Parasite Immunology and Immunodiagnostics	2
	ZOO-DSE-904	(Lab. Course)	2
	ZOO-DSE-905	Fish Culture, Adaptations and Health	2
	ZOO-DSE-906	(Lab. Course)	2

For the Students of other Departments

OGE	ZOO-OGE-901	Animal Resource	4
Total Credits:			24

For Four Credit Courses Marks shall be divided as follows:

CIA: 40 **ESE: 60**

For Two Credit Course Marks shall be divided as follows:

CIA: 20 **ESE: 30**

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Semester- X

	Code	Title of the Course	Credits
CORE	ZOO-CC-10-01	Comparative Animal Physiology	4
	ZOO-CC-10-02	Environmental Physiology	4
	ZOO-CC-10-03	Cell and Molecular Biology	4
	ZOO-CC-10-04	(Lab. Course)	4

Anyone from the Following Combinations

DSE	ZOO-DSE-10-01	Insect behaviour and control	2
	ZOO-DSE-10-02	(Lab. Course)	2
	ZOO-DSE-10-03	Emerging Zoonotic and Parasite Management	2
	ZOO-DSE-10-04	(Lab. Course)	2
	ZOO-DSE-10-05	Fish Resource, Collection and Preservation	2
	ZOO-DSE-10-06	(Lab. Course)	2

For the Students of other Departments

OGE	ZOO-OGE-10-01	Organic Farming	4
Total Credits:			24

For Four Credit Courses Marks shall be divided as follows:

CIA: 40 **ESE: 60**

For Two Credit Course Marks shall be divided as follows:

CIA: 20 **ESE: 30**

Semester-I
Animal Diversity (Non-Chordates)

ZOO-CC-101
Time: 60 Hours

Credits: 4
Max. Marks: 100

Unit I.

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

Unit II.

Functional anatomy and mode of life of Protozoa:-*Amoeba*, *Entamoeba*, *Plasmodium* and *Trypanosoma*. Porifera:-Canal system and skeletal system. Coelenterata:- Polymorphism, Coral and Coral reefs. Ctenophora:-General organization and Evolutionary significance. Nematelminthes and Platyhelminthes:- Life cycle and pathogenicity of *Wuchereria bancrofti*, *Taenia solium*, *Schistosoma mansoni* and *Schistosoma haematobium*.

Unit III.

Functional anatomy and mode of life of Annelida:- Evolution of Coelom, Metamerism and Excretion. Onychophora:- General anatomy, distribution and Evolutionary significance. Arthropoda:- Photoreceptors and Metamorphosis in insects. Mollusca:- General anatomy of *Pila*, Torsion and detorsion in Gastropods. Echinodermata:-Water vascular system in Asteroidea, Larval forms in Echinodermata.

UNIT IV.

Structure and Functions of the Invertebrates: Digestion: filter feeding in Invertebrates with special reference to Polychaetes. Respiration: Structure and functions of Gills, Trachea and Book lungs. Circulation: Types of Circulatory systems and blood composition in Non-Chordates. Excretion: Structure and functions of Protonephridia and Metanephridia. Reproduction: Asexual (Fission, Parthenogenesis and Regeneration in Non-Chordates.

Suggested Reading:

- Barnes, R.D. (1982). Invertebrate Zoology, V Ed. Holt Saunders International Edition.
- Boolotian & Stiles. 1981. College Zoology (10th Ed.)
- Dorit, Walker & Barnes.1991.Zoology (Saunders)
- Marshall & Williams.1972. Text book of Zoology. Vol. I (Parker & Haswell,7th Ed.)
- Nigam. 1997. Biology of Non-Chordates (S. Chand)
- Villee, Walker & Baranes. 1979. General Zoology 5th Ed. Saunders
- Hoar,2005.General and Comparative Physiology (5th Ed. Cambridge)
- Barnes, R.S.K., Calow,P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A new synthesis, III Ed. , Blackwell Science.
- Moore: An introduction to the invertebrates (2006, Cambridge)

Semester- I
Cell Biology

ZOO-CC-102
Time: 60Hours

Credits: 4
Marks: 100

UNIT I (Introduction & Cell Membrane)

15 lectures

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II (Cell Organelles)

15 lectures

Endoplasmic reticulum: Structure, function including role in protein segregation/Trafficking. Golgi complex: Structure, biogenesis and functions including role in protein secretion. Brief idea of vesicle transport. Endocytosis, Pinocytosis and Phagocytosis. Lysosomes: Vacuoles and micro bodies: Structure and functions. Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Peroxisomes Nucleus: Structure and function, chromosomes and their structure.

UNIT III (Cytoskeleton & Cell-Cell interactions)

15 lectures

Structure and function of microtubules, Microfilaments, Intermediate filaments. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.

UNIT IV (Cell cycle & signalling)

15 lectures

Cell cycle – Mitosis and Meiosis, regulation of cell cycle. Autocrine, paracrine and endocrine signaling. Molecular Mechanism of action of hormones, Types of receptors and action. GPCR signaling, Second Messengers - cAMP, cGMP, IP₃, DAG, Ca²⁺, NO (importance and role in signaling and signal transduction). Receptor tyrosine kinases.

Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th 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. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Semester - I

Laboratory Course (ZOO-CC-103)

(Corresponding theory papers ZOO-CC-101 and ZOO-CC-102)

Credit: 2

Max. Marks: 50

Time: 30 Hours

A. Practicals for Animal Diversity (Non-Chordates)

1. Study of the salient features of the following Non-chordates:

(*Amoeba, Euglena, Giardia, Trypanosoma, Paramecium, Leucosolenia, Sycon, Euplectella, Spongilla, Euspongia, Obelia, Hydra, Aurelia, Tubipora, Metridium, Planaria, Fasciola, Diphylobothrium, Taenia solium, Ascaris, Dracunculus, Necator, Nereis, Pheretima, Hirudo, Peripatus, Palaeomon, Buthus, Leucifer, Limulus, Scorpion, Tick, Honey bee, Louse, Butterfly, beetle, Chiton, Unio, Sepia, Octopus, Starfish, Holothuria*).

2. Study of the following through permanent slides:

Conjugation of *Paramecium*; Larval forms of Echinodermata and *Fasciola hepatica*.

3. Slide preparation of the following:

- Paramecium (whole mount).
- Septal nephridia and Ovaries of Earthworm
- Larval forms of Crustacea.
- Mouthparts of Cockroach, House fly and Mosquito.
- Trachea and Malpighian tubules of Cockroach.

4. Field survey for collection and identification of the following Non-Chordates:

- Insects.
- Earthworms.
- Parasites of sheep and Goat.

5. Dissections of the following:

- Earthworm-** Digestive system, Reproductive system, Nervous system.
- Cockroach-** Digestive system, Reproductive system and Nervous system.

B. Lab. Exercises for Cell Biology

- Observations on the permeability of Plasma membrane- effect of Isotonic, Hypotonic and Hypertonic solutions on Mammalian R.B.Cs.
- Preparation of temporary mount of onion root tip to show Mitosis cell division.
- Preparation of temporary mount of grasshopper testis to show Meiosis cell division.
- Preparation of temporary mount of Polytene chromosome from salivary glands of *Drosophila* larva.
- Buccal Smear- Identification of Barr body.

➤ Any other Practical found feasible by the teacher.

**Semester- I Fundamentals of
Biochemistry**

ZOO-CC-104

Time: 60 Hours

Credits: 4

Max. Marks: 100

Unit I (Amino acids, Proteins and Carbohydrates)

15 lectures

Introduction to Biochemistry: A historical perspective. Amino Acids and Proteins: Structure and function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different level of structural organization of proteins, Protein purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. Carbohydrates: Structure, function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoproteins and their biological functions.

Unit II (Lipids, Nucleotides and Nucleic Acids)

15 lectures

Lipids: Structure and functions- Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. Nucleic acids: Structure and functions: physical and chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines and pyrimidines. Biological significance of nucleotides. Double helical model of DNA structure and forces responsible for A,B & Z-DNA, denaturation and renaturation of DNA.

Unit III (Enzymes)

15 lectures

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, metalloenzyme, monomeric & oligomeric enzymes, activation energy and transition stage, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria, Role of NAD⁺, NADP, FMN/FAD, coenzyme A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

Unit IV (Carbohydrate and Fatty acids Metabolism)

15 lectures

Carbohydrate metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. β -oxidation of fatty acids.

Suggested Readings:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H. Freeman & Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of plant Biologists.
3. Nelson, D. L., Cox, M.M. (2004). Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York

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

Semester - I
ZOO-CC-105

Laboratory Course: Fundamentals of Biochemistry

Time: 30 Hours

Credits: 2

1. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
2. Principles of Colorimetry: (i). Verification of Beer's law, estimation of protein (ii) To study relation between absorbance and % transmission.
3. Preparation of buffers.
4. Qualitative tests for carbohydrates, lipids and proteins.
5. Estimation of blood glucose by glucose oxidase method.
6. Separation of Amino acids by paper chromatography.
7. Demonstration of dialysis.
8. Any other Practical found feasible by the teacher.

Semester I

BOTANY OPTION

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

ZOO-GE-103

Time: 60 Hours

Credits: 4

Max. Marks: 100

Unit 1: Microbes

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit 2: Algae and Fungi

General characteristics; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae. Fungi- General characteristics, cell wall composition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations- Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 3: Bryophytes

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 4: Pteridophytes and Gymnosperms

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance. General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Suggested Readings:

- 1.Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
- 2.Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
- 3.Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- 4.Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
- 5.Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
- 6.Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
- 7.Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- 8.Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Semester - I
BOTANY OPTION
Laboratory Course

ZOO-GE-104

Time: 30 Hours

Credits: 2

Max. Marks: 50

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
7. Gram staining
3. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus** and *Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
4. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
5. *Alternaria*: Specimens/photographs and tease mounts.
6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
7. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
9. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
10. ***Marchantia***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
11. ***Funaria***- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
12. ***Selaginella***- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
13. ***Equisetum***- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s. rhizome (permanent slide).
14. ***Pteris***- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
15. ***Cycas***- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
16. ***Pinus***- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Semester - I CHEMISTRY
OPTION INORGANIC
CHEMISTRY I

ZOO-GE-101
TIME : 60 HOURS

CREDITS: 04
M.MARKS: 100

Unit-I: Atomic Structure

15 lectures

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need for the quantum mechanical approach to atomic structure.

Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations.

Unit-II : Chemical Bonding and Molecular Structure

15 lectures

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and hetero-nuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches

Unit-III: s- and p-Block Elements-I

15 lectures

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Concept of unusual oxidation states, inert pair effect, diagonal relationship and

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anomalous behaviour of first member of each group.

Hydrides: Classification and general properties.

Concept of multicentre bonding in diborane and higher boranes.

Unit-IV: s- and p-Block Elements-II

15 lectures

Effective nuclear charge and its calculation using Slater rules; chemical characteristic of the compounds of alkali and alkaline earth metals (oxides and hydroxides).

Structure, bonding and their important properties of hydrides of Nitrogen (NH_3 , N_2H_4 , N_3H , NH_2OH); oxoacids of Phosphorous, Sulphur and Chlorine, halides and oxohalides (PCl_3 , PCl_5 , SOCl_2 and SO_2Cl_2).

Preparation properties and uses of some commercially important compounds: Calcium carbonate and Calcium Sulphate.

Books Recommended

1. J. D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
2. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press.
4. Gary Wulfsberg: *Inorganic Chemistry*, Viva Books Pvt. Ltd. J. C. Kotz, P. M. Treichel,
5. J. R. Townsend, *General Chemistry*, Cengage Learning India Pvt. Ltd. : New Delhi (2009).
6. B. H. Mahan: *University Chemistry*, 3rd Edn. Narosa (1998).
7. R. H. Petrucci, *General Chemistry*, 5th Edn., Macmillan Publishing Co.: New York (1985).

Semester - I

Laboratory Course in Inorganic Chemistry

ZOO-GE-102

TIME: 30 HOURS

CREDITS: 02

MAX. MARKS: 50

A. Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$

B. Qualitative Analysis

Semi-micro qualitative analysis using H_2S of mixtures- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+ , Pb^{2+} , Ag^+ , Bi^{3+} , Cu^{2+} , Cd^{2+} , Sn^{2+} , Fe^{3+} , Al^{3+} , Co^{2+} , Cr^{3+} , Ni^{2+} , Mn^{2+} , Zn^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , K^+

Anions : CO_3^{2-} , S^{2-} , SO_3^{2-} , $\text{S}_2\text{O}_3^{2-}$, NO_3^- , CH_3COO^- , Cl^- , Br^- , I^- , NO_3^- , SO_4^{2-} , PO_4^{3-} , BO_3^{3-} , $\text{C}_2\text{O}_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

- Any other practical found feasible by the teacher concerned.

Reference Books:

1. A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. Advanced Practical Inorganic Chemistry; Gurdeep Raj; 24th ed.; Goel Publishing House; 2012

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Semester - I

AEC- 101

TIME : 30 HOURS

Communicative English

CREDITS: 02

Unit – I

Spoken English: Practice in the correct pronunciation of English vowels and consonants, syllables and accent, International Phonetic Alphabet (IPA) basics – to enable the students to consult an English pronouncing dictionary.

Unit – II

Usage of English Language: Vocabulary development, word structure, word order and phrasal verbs

Unit – III

Comprehension: Listening and Reading Comprehension, Written Communication and Composition: Paragraph writing, précis writing, dicto composition, letter writing, writing a term paper, writing book reviews

Unit – IV

Essentials of Grammar: Remedial exercises in parts of speech, structure of sentences, sequence of tenses, use of articles and modes of reporting.

In addition to these components, students would be involved in performing communicative tasks such as making short speeches, interpreting visual presentations, role play and group discussions.

Recommended Reading:

Mohan, Krishna and Raman, Meenakshi, Effective English Communication, New Delhi: Tata McGraw Hill, 2000.

Semester II

Core Course: Zoology

ZOO-CC-201 [Animal diversity (Chordates)]

Credit 4

Time: 60 hours

Max. Marks: 100

Unit I.

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

Unit II.

Anatomy and mode of life of Protochordates: *Herdmania* and *Amphioxus*:- organization and development. Pisces:- Chondrichthyes and Osteichthyes- General account, Migration and Osmoregulation in fishes. Amphibia:- Type study of frog, metamorphosis in frog; General organization and development in Salamander.

Unit III.

Reptilia: Origin of Amniotes, affinities and general organization of Sphenodon; General organization of tortoise; Venomous and Non-venomous snakes of India, biting mechanism in snakes; General organization and classification of Crocodilia, Extinct Reptiles (Dinosaurs)

Unit IV.

Aves: General characters of Archeopteryx and its evolutionary significance; General organization of birds; flightless birds and their distribution, flight adaptations in bird. Mammals:- Prototheria (General organization). Eutheria: General organization of ungulates with special reference to the structure of stomach. Classification and characteristic features of Primates.

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 (6th Ed.)
7. Schmidt, N. 2005. Animal Physiology (5th Ed.)
8. Hoar, 2005. General and comparative Physiology (7th Ed.) Indian print

Semester - II
Core Course: Zoology

ZOO-CC-202 [Genetics]

Time: 60 hours

Credits:4

Max. Marks: 100

Unit I.

Mendelian genetics and its Extension: Mendel's laws of inheritance (monohybrid and dihybrid crosses with examples); Incomplete dominance and Co-dominance; Multiple alleles, lethal alleles, Epistasis and Pleiotropy. Sex linked inheritance in human beings.

Unit II.

Linkage, Crossing Over and Cytological basis of crossing over, molecular mechanism of crossing over; Two factor and three factor crosses; Interference and Coincidence; Somatic cell hybridization.

Unit III.

Mutations and Quantitative genetics - Gene mutations; Induced and spontaneous mutations; Chemical mutagens, Detection of mutations; Polygenic inheritance and Transgressive variations.

Unit IV.

Extra Chromosomal Inheritance and Human Genetics - Criteria for extra chromosomal inheritance- Mitochondrial mutation and maternal effects; Genetic disorders- Down , Turner and Klinefelter syndrome, chronic myeloid leukemia, cystic fibrosis and Phenylketonuria. Sex determination in man and animals and Organization of human genome, genetic counselling.

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 Genetic analysis. IX Ed

Semester - II

Laboratory Course (ZOO-CC-203)

(Corresponding theory papers ZOO-CC-201 and ZOO-CC-202)

Credit: 2

Time: 60 Hours

Max. Marks: 50

A. Practicals for Animal Diversity (Chordates)

1. Study of salient features of the following Museum Specimens:

Herdmania, Amphioxus, Lamprey, 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:

Dissection of Fish to show Gills, Digestive system and Afferent and Efferent Cranial nerves.

Dissection of lizard showing Digestive, Excretory and Reproductive systems.

Dissection of frogs showing internal anatomy and Arterial and Venous systems.

4. Field survey for collection and Identification of the following:

- 1. Frogs**
- 2. Birds**
- 3. Lizards**

B. Practicals for Genetics

1. Identification of various mutants of *Drosophila*.
 2. Pedigree analysis of some human inherited traits.
 3. Preparation of Polytene chromosomes from *Cheironomous/Drosophila* larva.
- Any other practical found feasible by the teacher concerned.

Semester-II

ZOO-CC-204 [Animal Physiology]

Credits: 4

Time: 60 Hours

Max. Marks:100

Unit I (Digestion & Respiration)

15 lectures

Digestion: Mechanism of digestion & absorption of Carbohydrates, Proteins, Lipids and Nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juices.

Respiration: Exchange of gases, Transport of O₂ and CO₂, Oxygen dissociation curve, Chloride shift.

Unit II

15 lectures

Composition of blood, Plasma proteins and their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, Cardiac cycle, origin and conduction of heart beat.

Unit III

15 lectures

Structure of Cardiac, Smooth & Skeletal muscles, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

Unit IV

15 lectures

Mechanism of generation and propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters. Mechanism of hormone action (insulin and steroids) Different Endocrine glands- Hypothalamus, Pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

Suggested Readings:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology XI Edition, John Wiley & sons, Inc.

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Semester - II

ZOO-CC-205

Time: 60 Hours

Laboratory Course: Animal Physiology

Credits: 2

1. Finding of coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.
4. Determination of TLC and DLC.
5. Determination of Haemoglobin.

Semester II
Botany Option

ZOO-GE-203
Max. Marks: 100
Lectures: 60

Plant Ecology and taxonomy
Credits: 4
M. Marks: 100

Unit 1: Ecological factors

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 2: Plant communities & Ecosystem

Characters; Ecotone and edge effect; Succession; Processes and types. Structure; energy flow trophic organisation; Food chains and food webs; Ecological pyramids, production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorus. Phytogeography: Principle biogeographical zones; Endemism.

Unit 3: Plant taxonomy and Taxonomic hierarchy

Identification, Classification and Nomenclature; Functions of Herbarium, important herbaria and botanical gardens of India; Documentation: Flora, keys: single access and multi access. Taxonomic ranks, categories and groups

Unit 4: Botanical nomenclature, Classification, Numerical taxonomy and Cladistics

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Semester-II

BOTANY OPTION

ZOO-GE-204

Time: 30 Hours

Laboratory Course

CREDITS: 2

Max. Marks: 50

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobancha*), Epiphytes, Predation (Insectivorous plants)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae - *Brassica*, *Alyssum* / *Iberis*; Asteraceae - *Sonchus/Launaea*, *Vernonia/Ageratum*, *Eclipta/Tridax*; Solanaceae - *Solanum nigrum*, *Withania*; Lamiaceae - *Salvia*, *Ocimum*; Liliaceae - *Asphodelus* / *Lilium* / *Allium*.
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Semester - II

CHEMISTRY OPTION

ZOO-GE-201

TIME : 60 HOURS

ORGANIC CHEMISTRY-I

CREDITS: 04

MAX. MARKS: 100

Unit-I : Fundamentals & Stereochemistry

(15 lectures)

Fundamentals of Organic chemistry

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of reactive Intermediates: Carbocations, Carbanions and free radicals. Nucleophiles and electrophiles Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans* nomenclature; R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit-II: Alkanes, Alkenes and Alkynes

(15 lectures)

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); *cis* alkenes (Partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions:* *cis*-addition (alk. KMnO₄) and *trans*-addition (bromine), Addition of HX (Markownikoff's and anti- Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄.

Unit-III: Aromatic hydrocarbons, Alkyl & Aryl Halides

(15 lectures)

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from

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benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl Halides

(Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1 , S_N2 and S_Ni) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation.

Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by $-OH$ group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit-IV Alcohols, Phenols, Ethers, (Upto 5 Carbons)

(15 lectures)

Alcohols: *Preparation:* Preparation of 1 $^\circ$, 2 $^\circ$ and 3 $^\circ$ alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Books Recommended:

1. T. W. Graham Solomon: *Organic Chemistry*, John Wiley and Sons.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
3. E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
4. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
6. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand

Semester - II

ZOO-GE-202

TIME : 30 HOURS

Chemistry Lab Course

CREDITS: 02

MAX. MARKS: 50

Laboratory Course in Organic Chemistry

1. Detection of elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).
 2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
 - (a) Separation and identification of the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
 - (b) Separation and identification of the sugars present in the given mixture by paper chromatography.
 3. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
 4. Criteria of Purity: Determination of melting and boiling points.
 5. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone
- Any other practical/s found feasible by the teacher concerned.

Books Recommended

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
 2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
 3. Advanced Practical Organic Chemistry, N. K. Vishnoi, Vikas Publishing House Pvt Ltd, 1996.
- Laboratory manual in Organic Chemistry, R.K. Bansal, (Wiley Eastern)

Semester - II
Environmental Sciences
ZOO-AEC-201

Time: 30 hours

Credits : 2

Marks: 50

UNIT I (Concept of environment)

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

UNIT II (Environmentalism)

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)

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

UNIT IV (Social Environmental Issues and Protection)

Environmental education, Public awareness. Role of mass media in environmental education. Human rights and environment. Environmental stewardship. Role of an individual in conservation of natural resources and biodiversity. Environment management Concept or Environmental protection through legislation (EPA act 1986) .International conventions: Stockholm Declaration, Kyoto protocol, Montreal protocol and Earth summit Challenges in environmental protection

Semester- III
Course : Zoology

ZOO-CC-301
Time: 60 Hours

Systematics and Evolution
Credits: 4
Max. Marks: 100

Unit I. Terms and Definitions of Systematics

Introduction to taxonomy, systematics and classification. Contribution of systematics to Biology; Binomial nomenclature. Trinomial nomenclature; Law of priority, Homonymy & Synonymy- brief introduction and ICZN rules pertaining to these terms and their interpretation. **15 periods**

Unit II. Species Category

Species concept (Typological & Biological- their advantages and limitations)); Sibling species, Polymorphic species; polytypic species; Allopatric, sympatric and parapatric species - their definition and examples. Mode of speciation (Allopatric).

15 periods

Unit III. Evolutionary theories & Process of Evolutionary change

Introduction to Evolutionary theories (Lamarckism, Darwinism, Neo-Darwinism); Evidences of evolution, Isolating mechanisms, Molecular clock concept. Natural selection (Industrial melanism, Pesticide/Antibiotic resistance); Types of Natural selection (Directional and Disruptive). Fossils and their significance **15 periods**

Unit IV. Evolution above species & Population genetics

Macro-evolutionary Principles (example: Darwin Finches); Convergent and Divergent; Molecular clock concept; Concept of gene pool; Gene frequencies- equilibrium frequency (Hardy-Weinberg equilibrium); Genetic drift, mutation pressure & gene flow

15 periods

Suggested Readings:

1. Meyr, E. Principles of Systematic Zoology.
2. Simpson, A. J. Animal Species.
3. Ridley, M. 2004. Evolution. III. Edition. Blackwell Publishing co.
4. Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D.B. and Patel, N. H. 2007 Evolution.. Cold Spring, Harbour Laboratory Press.

Semester- III
Course : Zoology

ZOO-CC-302

Credits: 4

Time Allowed: 60 Hours

Parasitology & Entomology

Max. Marks: 100

Unit I Parasitic Associations

15 periods

Brief introduction of parasitism, parasite (degree of parasitism) and vectors (Mechanical and Biological vector) Evolution of parasitism; Distribution of parasitism in animal kingdom. Host- parasite relationship. Parasitic adaptations in helminthes.

Unit II Pathogenecity, life cycle and control of Parasites

15 periods

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

Unit III Classification and Morphology of Insects

15 periods

Classification of insects- (Exopterygotes & Endopterygotes); Insect leg- Structure and modifications; Antennae- structure and types; Sound producing organs in insects with reference to stridulation in *Gryllus*, *Grasshoppers* and Light producing organs in fire fly

Unit IV. Pheromones/Endocrine glands in insects

15 periods

Insect pheromones and their significance; Endocrine glands in insects (Corpora allata, Corpora Cardiaca and Prothoracic gland); Chemical defence in insects; Adaptive radiation in insects (Mimicry & Adaptive colouration).

Suggested Readings:

1. Arora, D.R. and Arora, B. (2001). Medical Parasitology II Ed. CBS 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.

Semester - III
Laboratory Course based on ZOO-CC-301 & ZOO-CC-302
ZOO-CC-303

Time: 30 Hours

Credits: 02
Max. Marks: 50

1. Study of different morphological characters of Grasshopper , Butterfly & Beetle.
2. Study of morphological characters of local Amphibians and Reptiles.
3. Study of Homologous and Analogous organs from suitable specimens.
4. Study of fossil evidences from plaster cast models and pictures.
5. Collection and Identification of common fish parasites.
6. Collection and Identification of parasites of poultry.
7. Study of morphological characters of *Trichinella spiralis*, *Diplozoon*, *Giardia intestinalis* and *Balantidium coli* with the help of permanent slides.
8. Visit to Forest/National park/Wild life Sanctuary to study the behaviour of animals.
9. Any other practical found feasible by the teacher.

Semester- III

ZOO-CC-304

Time: 60 Hours

Molecular Biology

Credits: 4

Max. Marks:100

UNIT I: (DNA Structure & Replication)

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex. Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

15 periods

UNIT II: (DNA damage & Repair)

DNA damage and repair: Physical and chemical DNA damaging agents causes and types of DNA damage. Mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair.

Cancer: Normal vs cancer cell. Carcinogens. Tumor suppressor genes and oncogenes – a general account.

15 periods

UNIT III: (RNA Structure & Function)

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, elongation and termination. RNA splicing and processing: processing of pre-mRNA: 5' cap formation, Splicing and polyadenylation.

15 periods

UNIT IV: (Gene Expression)

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation, Posttranslational modifications of proteins.

15 periods

SUGGESTED READING

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.
5. Lewin Benjamin Lewin's Genes X (English) 10 Rev ed Edition
6. Goldstein, Kilpatrick, Krebs Lewin's Genes XI (English) Jones & Bartlett Publishers
7. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Semester- III
(Laboratory Course based on ZOO-CC-304)
ZOO-CC-305

Time: 30 Hours

Credits: 2
Max. Marks:50

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity
7. Any other practical found feasible by the teacher.

Semester - III

ZOO-GE-301

Credits: 4

Physical Chemistry-I

Max. Marks:100

Unit I Gaseous State

Deviation of gases from ideal behavior, van-der Waal's equation of state.

Critical Phenomenon: PV isotherms of real gases, continuity of states, the isotherms of vander Waal's equation. Relationship between critical constants and van-der Waal's constants, the law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities; qualitative discussion of the Maxwell's distribution of molecular velocities. Collision number, mean free path and collision diameter. Liquification of gases based on Joule-Thomson effect and adiabatic expansion.

15 periods

Unit-II Liquids:

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. Colloidal State: Classification of colloids, solids in liquids (sols): Preparation and Properties of colloidal solutions, kinetic, optical and electrical properties. Stability of colloids, protective action, Hardy-Schulze rule and gold number. Emulsions: Types of emulsions and their preparations, oils, soaps and detergents, cleansing action of soaps, CMC and its determination Gels: Classification, preparation and properties, Imbibition and general applications of colloids.

15 periods

Unit-III Solids:

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of crystallography:- (i) Law of constancy of interfacial angles (ii) Law of rational indices and (iii) Law of symmetry. Symmetry elements in crystals, Lattice planes and Miller indices. X-ray diffraction by crystals, derivation of Bragg's equation and its application. Interplanar distances in terms of miller indices. Determination of crystal structure by Laue's method and powder method. Systematic absence of diffraction lines in the X-ray pattern of cubic crystals with reference to NaCl, KCl & CsCl.

15 periods

Unit-IV Chemical Kinetics:

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

15 periods

Reference Books:

1. The elements of Physical Chemistry ; P.W. Atkins ; Oxford University Press.

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

2. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania ; S. Chand & Co.
3. A Text Book of Physical Chemistry - Vol. I & II ; K. L. Kapoor; MacMillan India Ltd.
4. Text Book of Physical Chemistry ; K.K Sharma; Vikas Publishing House.
5. A Text Book of Physical Chemistry ; A.S. Negi & S.C Anand ; Wiley Eastern Ltd.
6. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
7. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).

Semester - III
Lab. Course
ZOO-GE-302

Credits: 2
Marks: 50

1. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's Viscometer.
2. Determination of percentage composition of a binary liquid mixture by viscosity method.
3. Determination of molar mass of polymer by viscosity method
4. Study of the variation of viscosity of an aqueous solution with concentration of solute.
5. Acid hydrolysis of methyl acetate with hydrochloric acid.
6. Compare the strength of HCL and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate.
7. Measurement of pH of different solutions using pH-meter (pH modulators, pl, Titration curve of amino acids).
8. Any other practical found feasible by the teacher.

Suggested Reading:

1. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

Semester-III
Botany Option

ZOO-GE-303

Credits: 4

Anatomy of Angiosperms

Max Marks:100

Unit 1: Tissues

Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. 15 periods

Unit II: Stem, Leaf, Root

Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root. 15 periods

Unit III: Vascular Cambium and Wood

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. 15 periods

Unit IV: Adaptive and Protective Systems

Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes. 15 periods

Suggested Readings

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergamon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
4. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi.

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

Semester - III
Lab. Course based on GE-303
ZOO-GE-304

Credits: 2

Max.Marks:50

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.
 - Any other practical found feasible by the teacher

Semester- III
Skill Enhancement Course
APICULTURE
ZOO-SEC-301

Time: 30 Hours

Credits: 02

Max. Marks: 50

Unit I Biology & Classification

Biology and classification of honey bee species. Social organization in honey bees.
Different species of honey bees used in honey production.

Unit II. Requirements for Apiculture

Bee hive structure and temperature regulation. Methods of bee keeping.- Indigenous methods of Extraction of honey. Flora for apiculture- selection of bees for apiculture.

Unit III. Method, Appliances and Honey bee diseases

Modern methods of Apiculture- Appliances for modern method. Diseases of honey bee and control measures.

Unit IV Honey & Bee Wax

Bee enemies, Products of bee keeping - Honey (chemical composition). Economic importance of Honey bee wax.

NOTE: Visit to Apiary.

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.

Semester-III

Skill Enhancement Course

Organic Farming

ZOO-SEC-302

Credit: 2

Max. Marks: 50

Time: 30 Hours

Unit I: Concept of organic farming

7 lectures

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

8 lectures

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

7 lectures

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

8 lectures

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

Semester- IV
Course: Zoology
Comparative Anatomy of Vertebrates
ZOO-CC-401

Time: 60 Hours

Credits: 04

Max. Marks: 100

Unit I. Integumentary and Skeletal Systems

Integumentary system: Derivatives of the Integument, Epidermal derivatives: glands; Epidermal Scales, Horns, Feathers & Hair. Bones-Axial Skeleton, Jaw suspensorium, Characteristic of Amphibian Skull, Characteristic of Reptilian Skull; Girdles and Limbs of terapods.

15 periods

Unit II. Digestive and Respiratory systems

Digestive system:- Alimentary canal and associated glands. Respiratory system :- skin, gills (external and internal gills) lungs and air sacs; accessory respiratory organs, swim or air bladder

15 periods

Unit III. Circulatory & Urinogenital systems

Circulatory system:- General plan of circulation, evolution of heart and aortic arches. and modifications in 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

15 periods

Unit IV. Nervous system & Sense organs

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

15 periods

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 McGraw Hills
4. Hilderbrand, M. and Gaslow, G.E. Analysis of Vertebrate Structure. John Wiley and sons

Semester- IV
Course: Zoology
Applied Zoology
ZOO-CC-402

Time: 60 Hours

Credits: 04

Max. Marks: 100

Unit I: Parasites & their pathogenecity

Introduction to Host parasite relationship. Host: Definitive host and Intermediate host, parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis; Life cycle and pathogenesis and control of Medically and veterinary important parasites such as: *Fasciola hepatica*, *Echinococcus granulosus*, *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichuris trichura* and *Enterobius vermicularis*. **15 periods**

Unit II. Economic Entomology/Vermiculture

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 -Brief account **15 periods**

Unit III Aquaculture

Fish culture (General account of Trout culture); Induced breeding in fish and prawn. Management of Hatchery of fish; Fish diseases- bacterial, Viral and Fungal. Fishery bye products; Prawn Culture- General Account. **15 periods**

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. **15 periods**

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.

Semester - IV
(Laboratory Course based on ZOO-CC-401 & ZOO-CC-402)
ZOO-CC-403

Time: 30 Hours

Credits: 02
Max. Marks: 50

1. Study of placoid, cycloid and ctenoid scales through permanent slides.
 2. Mounting of placoid scales.
 3. Disarticulated skeleton of Frog/Fowl.
 4. Carapace and Plastron of Tortoise/Turtle.
 5. Study of morphological characters of honey bee.
 6. Study of morphological characters of Bombyx mori.
 7. Collection of *Fasciola hepatica* 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.
- Any other practical found feasible by the teacher.

Semester- IV

ZOO-CC-404

Time: 60 Hours

Immunology

Credits: 4

Max. Marks:100

UNIT I (Basic Immune System)

Historical perspective, Types of Immunity – Innate (anatomical barriers, Toll like receptors, complement system and its regulation), Inflammation, Adaptive Immunity – Cell and Humoral immunity– Haematopoiesis – Cells of Immune System -B cell, T cell, APC, NK Cells. Cytokines. Clonal selection theory. Lymphoid organs – Primary (Thymus, Bone marrow, Bursa of Fabricus), Secondary Lymphoid Organs – Lymph node, Spleen, Payer's patches (GALT), Tonsils (MALT) – Development and maturation of Lymphocytes. **15 periods**

UNIT II (Antigens & Antibody)

Antigens and superantigens (properties) and Antibodies (structure of antibody) – different types. Allotypes, Isotype & Idiotypes. Brief idea of Antigen-antibody interactions (precipitation, agglutination, cytolysis, complement fixation, flocculation, opsonisation). Immunologic memory. Hypersensitivity (types). **15 periods**

UNIT III (Antigen processing)

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defence strategies, avoidance of recognition. Transplant & Cancer Immunology (Brief idea). Autoimmune diseases, Immunodeficiency disorders (AIDS). **15 periods**

UNIT IV (Vaccines & Immunotechniques)

Vaccines & Vaccination – adjuvants, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Monoclonal Antibodies. Introduction to different immunodiagnostic techniques like RIA, double diffusion, Mancini radial immunodiffusion, ELISA, Western blot. **15 periods**

Suggested Reading:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.

Semester - IV

(Laboratory Course based on ZOO-CC-404)

ZOO-CC-405

Time: 30 Hours

Credits: 2

Max. Marks:50

1. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
2. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
3. Enzyme linked immune-sorbent assay (ELISA).
4. Separation of serum from blood
5. Any other practical found feasible by the teacher.

**Semester IV Inorganic
Chemistry-II
ZOO-GE-401**

TIME : 60 HOURS

CREDITS: 04

MARKS: 100

Unit I: Transition & Inner-Transition Elements

15hours

Variation in atomic and ionic sizes, Ionization enthalpies, Variable oxidation states. Standard electrode Potentials of M^{2+} / M and M^{3+} / M^{2+} systems.

Ionic / Covalent and Acidic /Basic character of transition metal compounds in various oxidation states. Stabilization of unusual oxidation states. Spectral and Magnetic Properties; Calculation and uses of magnetic moment value.

Electronic Configuration, Oxidation States, Magnetic Properties and Complexing behaviour of inner transition elements. Cause and Consequences of Lanthanoid / Actinoid Contraction. Separation of Lanthanoids:- Fractional Crystallization, Ion-exchange and Solvent extraction methods.

Unit II: Coordination Compounds

15hours

Experimental verification of Werner's theory. Effective Atomic number : Concept and its significance. Stereochemistry of Coordination compounds:- With numbers (2-6); Optical and Geometrical isomers of MA_4B_2 , MA_3B_3 and $MABCD$ type Complexes. Bonding in Complexes:- Comparison of valence bond and Crystal field theories; CFT of tetrahedral, square planar and octahedral systems. Factors affecting magnitude of Δ ; pairing energy and CFSE of weak and strong field ligands. Limitations of Crystal field theory and the applications of Coordination compounds.

Unit III: Chemical Spectroscopy I

15 hours

Introduction; Born-oppenheimer approximation (statement only); Rotational Spectrum Selection rules, Energy levels of rigid rotator (semi-classical principles), rotational spectra of diatomic molecules; relative population of rotational levels and spectral intensity, determination of bond length and isotopic effect.

Vibrational spectroscopy: Simple harmonic oscillator (classical and qualitative quantum mechanical treatment); Vibrational spectra of a diatomic molecule, determination of force constant and its relation with bond length and bond energy. Vibrational degree of freedom.

Raman spectroscopy: Polarizability. Stokes and anti-Stokes lines-selection rules. Comparison of Raman spectroscopy and IR spectroscopy.

Electronic spectroscopy: Types of electronic transitions, Selection rules and Franck-Condon principle.

Unit IV: Bioinorganic Chemistry

15 hours

Metal coordination behaviour of Proteins, Nucleic acids and Lipids. Concept and Criteria for essentiality of elements in living systems.

Distribution and biological role of essential elements in life: Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Fe^{2+} and halogens.

Metalloporphyrins: Structure and Biological role of Haemoglobin, myoglobin & Chlorophyll.

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Metallo biomolecules, classification and biological functions, Structure and Biological role of Carbonic anhydrase.

Reference Books:

1. Concise Inorganic Chemistry ; J.D. Lee; ELBS.
2. Advanced Inorganic Chemistry ; Volume 1; S. Prakash; G.D. Tuli ; S.K. Basu & R.D . Madan; S.Chand & Company Ltd.
3. Coordination Chemistry; D.Banerjee ; Tata Mc Graw Hill.
4. Concise Coordination Chemistry ; R. Gopalan & V. Ramalingam ; Vikas .
5. Basic Inorganic Chemistry; F.A. Cotton. G. Wilkinson & P.L. Gauss ; Wiley.
6. Inorganic Chemistry ; D.E Shriver; P.W. Atkins & C.H. Langford ; Oxford.
7. Inorganic Chemistry ; Gary Wulfsberg ; Viva; 2002 .
8. Concepts and Models of Inorganic Chemistry ; 3rd edn.; B.Douglas ; D.McDaniel ; J. Alexander ; Wiley ; 2001.
9. Vogel's Text of Quantitative Inorganic Analysis ; J. Bassett ; R.C. Denny ; ELBS.
10. Analytical Chemistry ; G.D. Christian ; 5th edn. ; Wiley ; 2001.

Inorganic Chemistry Practical 2

ZOO-GE-402

Credits: 2

Max. Marks:50

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.
4. Estimation of Ca^{2+} in solution by (substitution method) using Erio-chrome black-T as indicator.
5. Estimation of Ca/Mg in drugs and Biological samples.
6. Estimation of Cl^- (i) By Mohr's method, (ii) By Vohlard's method, (iii) By Fajan's method.
7. Paper Chromatographic separation of Ni (II) and Co(II); Cu(II) and Cd (II).
8. Any other practical found feasible by the teacher.

Books Recommended:

1. Vogel's Qualitative Inorganic Analysis; 6th edn; Svehla (Longman, 1994)
2. The physical Chemistry of Inorganic Qualitative analysis; Kuriacose, Rajaram (Tata MGH, 1972).
3. Vogel's Textbook of Quantitative chemical Analysis; 5th edn; Jeffery, Bassett; (ELBS, 1989).
4. Quantitative Analysis; 6th edn; Day, Underwood (Printice Hall, 1993).
5. Chromatographic Methods; 3rd ed; Stock & Rice (Chapman & Hall, 1980).
6. Analytical Chemistry; 5th ed; D. Christian (Wiley)

Semester-IV
Botany Option

ZOO-GE-403
Lectures: 60

Economic Botany
Credits: 4
Marks: 100

Unit-1: Origin of cultivated plants & their importance

Concept of centre's of origin of crop plants, their importance with reference to Vavilov's work, example of major plant introduction.

Concept of germplasm, gene pool and genetic erosion; Crop domestication and loss of diversity.

Evolution of major crop plants (wheat, cotton and triticales), Importance of plant quarantine in introduction of new crops.

15 periods

Unit-II: Food plants and spices

Food plants: Morphology, cultivation and economic importance of wheat, rice and potato.

Legumes: Cultivation and economic importance with special reference to gram and soybean.

Spices and condiments: Important spices of Kashmir (list only); Source, plant part used and uses with special reference to saffron, capsicum, cardamom.

15 periods

Unit-III: Medicinal Plants, oils and fruits

Medicinal and aromatic plants of Kashmir (MAPs – list 10-15 plants only); Morphology, part used and uses of podophyllum, saussurea & lavendula.

Oil seeds: General description, extraction, uses and health implications of groundnut and mustard oil.

Fruits: Classification, botany and uses of some common fruits - apple, almond, cherries, walnut.

15 periods

Unit-IV: Beverages, Fibres and Timber plants

Beverages: Morphology, cultivation and processing of tea.

Fibres: Classification of fibres, morphology, cultivation, extraction and utilization of cotton and jute.

Wood: General account and economic importance of timber yielding plants of Kashmir (Pinus & cidrus).

General account of various pulses grown in Kashmir.

15 periods

Suggested Readings

1. Frankel, O.H. and Hawkes, J. G. 2006. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press
2. Wikens, G. E. 2004. Economic Botany- Principles and Practices. Kluwer Publisher Academy, Netherlands
3. Gonsalves, John. 2007. Economic Botany and Ethnobotany. Vedam Books
4. Simpson, B.B. and Ogorzally, M.C. 2003. Economic Botany- Plants in our World. McGraw Hill International Publishers.
5. Johri, B. M. and Srivastava, P.S. 2007. Reproductive Biology of Plants. IBH Publishers.
6. Singh, Prithipal. 2007. Biodiversity Conservation and Systematics. Scientific Publishers.
7. Poehlman, J. H. 2001. Breeding Field Crops. Avi publishing Company
8. Love, D. 1992. Origin and Geography of Cultivated Plants by N. I. Vavilov, Cambridge University Press.

Semester - IV

Lab. Course

Zoo-GE-404

Credits: 2

Marks: 50

1. To study the morphology and food reserves of food plants like rice, wheat, maize, potato through chemical tests.
2. To demonstrate the distribution of surface (cotton) and bast fibres (hemp) (morphology and anatomy).
3. Study botany, part used and uses of some medicinal and aromatic plants Lavendula, Artimesia, Saussurea (or as per availability in local area).
4. Study the distribution of oil bodies in some oil containing seeds (mustard, groundnut, walnut etc)
5. Examine morphologically some common spices.
6. Prepare an illustrated inventory of 10 medicinal plants used in traditional systems of medicine.

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Semester- IV
Skill Enhancement Course
Public Health and Hygiene
ZOO-SEC-401

Time: 30 Hours

Credits: 02

Max. Marks: 50

Unit I: Public Health and Hygiene

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

Unit II: Environment & Health Hazards

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

Unit III: Communicable diseases

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

Unit IV: Non-Communicable diseases

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)

Scheme for Five year Integrated B. Sc., M. Sc. programme in Zoology under CBCS

Semester-IV IT SKILLS ZOO-SEC-402

Time: 30 hours

Credits: 02

Marks: 30

Unit I (Introduction to Information Technology)

Information Technology: Data, Information, Application of IT; Computer: Definition, Characteristics, Application; Components of Computer System: Central Processing Unit(C.P.U), Input and Output Devices; Memory; Concept of Hardware and Software, Classification of computers. Introduction to Operating Systems (D.O.S, Windows and Linux).

Unit II (Application Software I)

Word Processing: Creating, Editing and Printing Documents. Formatting-paragraph and character styles, changing fonts and their sizes. Table: creation, concept of rows and columns, inserting and deleting rows and columns. Mail merge, Labels and Envelopes, Resume Creation. Paint: Drawing, picture editing, image file formats.

Unit- III (Application Software II)

Spreadsheets: Elements of Spreadsheets, Manipulation of Cells, Inserting and Deleting rows and columns: Formulae and Functions, using small Accounting Applications. Presentations: PowerPoint: Exploring, Creating and Editing slides, inserting Tables, charts and Multimedia, Animations, Slide Show. Introduction to ios.

Unit- IV (Computer Communication and Internet)

Computer Networks: LAN, MAN, WAN, Internet, Internet Applications, WWW, Web Browsers, Electronic Mail (e-mail): Creating email account, sending messages , attaching a document ; Viruses and Protection.

Emerging Trends in Information Technology:

Information Technology (I.T) Acts, I.T Application: Education, Industry, Health and Banking. E-Commerce, Geographic Information System (GIS), e-governance, Artificial Intelligence.

Suggested Reading:

- 1.V. Rajaraman, Computer Fundamentals, PHI.*
- 2.Leon and Leon, Fundamentals of IT, Leon Tec World.*
- 3.P. K Sinha, Computer Fundamentals, BPB Publications.*
- 4.Ron Mansfield, Working in Microsoft Office, Tata McGraw Hill.*
- 5.Alexis Lean and Mathews Leon, Fundamentals of Information Technology*

Scheme for Five year Integrated B. Sc., M. Sc. programme in Zoology under CBCS

Semester- V

Course: Zoology

**Animal Ecology
ZOO-CC-501**

Time: 60 Hours

Credits: 04
Max. Marks: 100

Unit I: Introduction to ecology

15 periods

Relevance of studying ecology, History of ecology, Autecology and synecology, levels of organization, Laws of limiting factors. Light and Temperature as physical factors. Types of Ecosystems.

Unit II: Population

15 periods

Population characteristics, Population density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal 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.

Unit III: Community

15 periods

Community characteristics: Dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect. Ecological succession and its types. Theories pertaining to climax community.

Unit IV: Food chain and Biodiversity

15 periods

Food chain, detritus and grazing food chains, Linear and Y-shaped food chains. Food web, energy flow. Ecological pyramids and ecological efficiencies. Nitrogen cycle. Biodiversity: Definition significance and types. Conservation strategies.

Suggested Readings:

1. Colinviaux, 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.

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Semester- V

Course: Zoology

**Wildlife Management and Conservation
ZOO-CC-502**

Time: 60 Hours

Credits: 04
Max. Marks: 100

Unit I: Wildlife conservation

15 periods

Wild life- values of Wild life- positive and negative; Conservation of wild life- importance and ethics; Causes of depletion; World conservation strategies. Protected areas, National parks and Sanctuaries. Tiger conservation- concept and challenges

Unit II: Evaluation and management of Wild life

15 periods

Habitat analysis, evaluation and management of wild life: Physical parameters: Topography, Geology, Soil water; Biological parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedure: remote sensing and GIS.

Unit III: Habitat management

15 periods

Management of Habitats- Setting back succession; Grazing logging; Mechanical treatment; Cover construction; Preservation of general genetic diversity. management and control of forest fire and soil erosion; Concept of sustainable development.

Unit IV: Wild life Legislations/Diseases of wild animals & Ecotourism

15 periods

National organizations involved in wild life conservation; Wild life Legislation- wild protection act-1972, its amendments and implementation; Eco tourism/ wild life tourism in forest; Management of excess population translocation; Care of injured and diseased animal; Common diseases of wild animals

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.

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(Laboratory Course based on ZOO-CC-501 and ZOO-CC-502)

ZOO-CC-503

Time: 30 Hours

Credits: 02

Max. Marks: 50

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/ real data provided.
2. Determination of population density in a natural/hypothetical community by Quadrant method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of aquatic ecosystem: fauna and flora. Measurement of temperature, turbidity/ penetration of light, determination of pH and dissolved Oxygen content, Chemical Oxygen Demand and free Carbon dioxide.
4. Visit to National Park/Biodiversity/Wildlife sanctuary.
5. Identification of mammalian fauna, avian fauna and herpeto-fauna.
6. Identification of animals through- pug marks, hoof marks, nests and antlers.

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Semester- V

Biotechniques
ZOO-CC-504

Credit: 4
Max Marks:100

UNIT I (Water, pH & buffers)

15 lectures

Water – structure, weak interactions in aqueous systems (Hydrogen bonding), unique properties, water as solvent, ionization of water. pH, Buffers, buffering capacity, pKa. Henderson-Hasselbach equation. Solution Concentrations (Molar, molal, normal, percent solutions, converting normality/molarity to percent, and dilutions).

UNIT II (Imaging techniques)

15 lectures

Principle & applications of microscopy (bright field, dark field, phase contrast, fluorescence & confocal microscopy). Electron microscopy –brief idea and applications of transmission and scanning electron microscope (TEM, SEM) & Scanning probe microscopy (Scanning tunneling microscope & AFM - atomic force microscope). Sample preparation for electron microscopy (freeze fracture, freeze etching, replica plating).

UNIT III (Centrifugation & Chromatography)

15 lectures

Centrifugation – basic principle & different types (differential centrifugation, density gradient centrifugation, ultra centrifugation) Cell fractionation, isolation of sub-cellular organelles and particles.

Introduction to different types of chromatography - Paper chromatography, thin layer chromatography. Column chromatography - gel filtration, affinity and ion exchange chromatography. Gas chromatography & HPLC.

UNIT IV (Electrophoresis)

15 lectures

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), 2-D gel electrophoresis, Agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, Isoelectric focusing, Blotting techniques.

Suggested Reading:

1. Freifelder, D. (1983) Physical Biochemistry 2nd edition, W.H. Freeman and Co., N.Y. USA.
2. Wilson & Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology Cambridge University Press.
3. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., WileyBlackwell
4. David Plummer (2001) An Introduction to Practical Biochemistry, McGraw Hill Education
5. Karp, G. 2010 (2013) Cell and Molecular Biology: Concepts and Experiments, John Wiley & Sons. Inc.
6. Cooper, G.M. and Hausman, R.E (2015) The Cell: A Molecular Approach, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
7. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P (2015) The World of the Cell, Pearson Benjamin Cummings Publishing, San Francisco
8. Irwin H. Segel (2010) Biochemical Calculations, Wiley.

Scheme for Five year Integrated B. Sc., M. Sc. programme in Zoology under CBCS

Semester- V

**Lab. Course
ZOO-CC-505**

**Credit:02
Max Marks: 50**

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of opening & closing of stomata
3. Separation of photosynthetic pigments (Chlorophyll).
4. Demonstration of aerobic respiration.
5. Any other practical found suitable by the teacher.

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Chemistry option

ZOO-GE-501

Semester V

Credits: 4

Time: 60 hrs

Max. marks:100

Organic Chemistry II

Unit-I: Carboxylic acid and its derivatives, Amines and Diazonium Salts: 15hrs

Carboxylic acid and its derivatives (aliphatic): Carboxylic acids (aliphatic and aromatic)
Preparation: Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohland - Zelinsky Reaction

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. *Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts: Amines (Aliphatic and Aromatic): (Upto 5 carbons), *Preparation:* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten – Baumann Reaction. Diazonium salts: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

Unit-II: Ultraviolet Spectroscopy 15hours

The electromagnetic spectrum. Beer-Lambert law, molar absorptivity, presentation and analysis of electronic spectra. Types of electronic excitations. Effects of conjugation and solvents on absorption. Chromophores and auxochromes. Bathochromic and hypsochromic shifts. Ultraviolet spectra of enes and enones. Prediction of maxima of enes and enones using Woodward's rules.

Unit-III: Infrared spectroscopy 15 hours

The infrared region. Molecular vibrations, significance of hook's law and selection rules. The infrared spectrum. Fingerprint region and its significance. Effect of resonance, inductive effect and H-bonding on infrared absorptions. Characteristic absorptions of Alkanes, alkenes, alkynes, alcohols, ethers, carbonyl compounds, amines and carboxylic acids and their derivatives.

Unit-IV: Nuclear Magnetic Resonance Spectroscopy 15 hours

Basic principles of NMR spectroscopy. Shielding and deshielding of protons. The chemical shift. Equivalent and non-equivalent protons. Spin-spin splitting, coupling constants for vicinal, geminal and long range couplings. The NMR spectra of ethyl bromide, ethanol, acetaldehyde, ethyl acetate, methyl propionate, toluene and acetophenone.

Books Recommended:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
 2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
 3. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
 4. Organic chemistry; I.G.Wade ; Prentice Hall.
 5. Fundamentals of Organic chemistry ; 5th edn. ; Solomons ; John-wiley.
 6. Organic chemistry ; Vol I, II & III ; Singh ; Mukherji & R. P. Kapoor ; Wiley-Eastern
 7. Text book of Organic Chemistry ; R.K.Bansal ; Wiley- Eastern ; 1997.
- Advanced Organic Chemistry ; B.S.Bahl and Arun Bahl ; (S.Chand ; 1996.

Lab course

Credit: 2

ZOO-GE-502

Max. Marks: 50

1. Differentiation between a reducing and a non reducing sugar.
2. Acetylation of one of the following compounds: amines (aniline, o-,m-,p- toluidines and o-,m-,p- anisidine) and phenols (β -naphthol, vanillin, salicylic acid)
3. Benzoylation of one of the following compounds: amines (aniline, o-,m-,p- toluidines and o-,m-,p- anisidine) and phenols (β -naphthol, resorcinol, p-cresol) by Schotten Baumann reaction
4. Hydrolysis of amides and esters to obtain benzoic acid.
5. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography.
6. Separation of a mixture of two sugars by ascending paper chromatography
7. Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC)

Reference Books:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press

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Botany Option

Semester: V

Course: ZOO-GE-503 Plant Physiology and Reproductive Biology Credit: 4
Max marks: 100

Unit: I

Plant water relations: importance of water to plant life; diffusion and osmosis; absorption, transport and transpiration mechanisms.

Mineral nutrition: Essential macro- and micro nutrient elements and their role; mineral deficiency symptoms.

Seed dormancy: physiology of dormancy; seed germination and factors regulating seed germination.

Physiology of flowering: Photoperiodism; vernalization

Unit-II

Photosynthesis: photosynthetic pigments; concept of two photosystems; photophosphorylation; photorespiration; C₃ and C₄ pathway, CAM plants.

Respiration: ATP- the biological energy currency; aerobic and anaerobic respiration; Krebs cycle; electron transport mechanism, oxidative phosphorylation (chemi-osmotic mechanism).

Growth and development: differentiation and morphogenesis (elementary idea) ; phases of growth.

Unit: III

Sexual Reproduction: Flower - a modified shoot, structure of typical flower; functions and structure of anther and pistil.

Micro-sporogenesis - development of the male gametophytes,

Mega-sporogenesis - development of the female gametophytes

Types of pollination mechanisms; pollen -pistil interaction,

Concept and importance of Self incompatibility; double fertilization, Seed dispersal strategies in plants

Unit: IV

Vegetative reproduction: vegetative propagules and vegetative propagation by different methods; economic aspects.

Self and cross pollination mechanisms in crop plants

Hybridization technique and its utility in crop improvement

Role of mutation, polyploidy and biotechnology in crop improvement,

Apomixes and its utility (brief idea)

Suggested Readings

- Bhojwani, S. S. and Bhatnagar, S. P. 1985. The embryology of angiosperms. VaniPublications, New Delhi.
- Hopkins, W. G. and Huner, N. P. A. 2009. Introduction to Plant Physiology (4th Edition). John Wiley and Sons, Inc. USA
- Johri, B. M. 1984. Embryology of angiosperms. Springer-Verlag.
- Lersten, N. R. 2004. Flowering Plant Embryology. Blackwell Publishing Ltd, Oxford, UK.
- Mohr, H. & Schopfer, P. 1995. Plant Physiology. Springer-Verlag, Berlin Heidelberg
- Raghavan, V. 2000. Developmental Biology of Flowering Plants. Springer-Verlag Berlin Heidelberg, New York.
- Raghavan, V. 2006. Double fertilization: embryo and endosperm development in flowering plants. Springer-Verlag Berlin Heidelberg, New York.
- Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th ed.). Wadsworth Publishing Company, Belmont, California.

Lab.Course:
ZOO-GE-504

Credits: 2
Max marks:50

1. To study permeability of plasma membrane using different concentrations of organic solvents.
2. To study effect of temperature on permeability of plasma membrane.
3. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature.
4. Comparison of the rate of respiration of various plants.
5. Separation of chloroplast pigments by solvent method.
6. Determining the osmotic potential of vacuolar sap by plasmolytic method.
7. Determining the water potential of any tuber.
8. Demonstration of chromatographic separation of chloroplast pigments.
9. Study of different types of flowers in relation to sexuality and adaptation to pollination mechanisms (Maize, *Cannabis* and *Ranunculus*)
10. Study of the structure of anther, micro-sporogenesis, pollen grains and pollen viability through squash technique (any available material)
11. Study of the structure of ovule and embryo sac from prepared slides
12. Study of nuclear and cellular endosperm (Coconut, cucurbits)
13. Simple experiments to show vegetative propagation (cutting, layering and grafting)
14. Study of germination of non-dormant and dormant seeds (pea, maize, bean, tomato)

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Semester- V Personality & Entrepreneurship Development ZOO-SEC-501

**Credit: 2
Max. Marks: 50**

Unit I Introduction to Personality Development

7 lectures

Importance of Personality Development, Personality Development Tips, Importance of Character in PD, Personality Traits, Dressing and Personality Development, Communication Skills and PD, Role of PD in Organizational Success

UNIT II: Personality Assessment and indicators of successful person

7 lectures

Introspection & Interview (Personal interview, telephonic interview), Group Dynamics and Interpersonal Relations, Attitudes and Temperament, Social Responsibility and Community Work, Self Confidence, Life Style.

Unit III Introduction to Entrepreneurship

8 lectures

Entrepreneurship: Definition, characteristics and motivation, types and functions of an entrepreneur. Creativity & innovation. Women entrepreneurship: Schemes, Opportunities and problems.

Unit II Entrepreneurial Process:

8 lectures

Search and Selection/developing of a Business idea. Feasibility, planning and market survey/analysis techniques. Criteria for the principles of product selection, design and development. Preparing a business plan (steps, writing and presentation). Role of different organizations for promotion of entrepreneurship; State Financial Corporation, District Industries Corporation, Entrepreneurship Development Institute(EDI), SICOP.

Suggested Reading

1. Frey, D and Carlock, C. (1989). Enhancing Self Esteem. 2nd edition. Indiana: Accelerated Development INC.
2. John, Seely: The Oxford guide to writing and speaking. Oxford U P, 1998, Delhi.
3. Johnson, D.W. (1997). Reaching out – Interpersonal Effectiveness and Self Actualization. 6th ed. Boston: Allyn and Bacon.
4. Robbins, S. P. and Hunsaker, Phillip, L. (2009). Training in Interpersonal skills. Tips for managing people at work. 5th ed. New Delhi: PHI Learning
5. Entrepreneurship: New Venture Creation : David H. Holt
6. Vasant Desai, Kulveen Kaur (2013) Entrepreneurship Development and Management, Himalaya Publications.
7. Sharma Sangeeta, (2016) Entrepreneurship Development, PHI Learning Pvt. Ltd.
8. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.

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Semester- V

Sericulture

ZOO-SEC-502

Time: 30 Hours

Credits: 02

Max. Marks: 50

Unit I: Introduction to Sericulture

8 lectures

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 non traditional practices.

Unit II: Biology of mulberry silkworm

7 lectures

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

Unit III: Cowki Rearing

8 lectures

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 Cowki rearing- optimum conditions for Chowki rearing.

Unit IV: Silkworm rearing houses

7 lectures

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.

Suggested Readings:

1. Venkatanarasaiah, 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
- . Ganga, G. and J. Sulochna Shetty, 1991. An Introduction to Sericulture. Oxford IBH

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Semester- VI

Course: Zoology

Reproductive and Developmental Biology ZOO-CC-601

Time: 60 Hours

Credits: 04
Max. Marks: 100

Unit I: Reproductive organs & their regulation 15 periods

Brief introduction of male and female reproductive organs in human. Gonadal Hormones. Regulation of gonadotrophin secretion in male and female. Corpus luteum formation and regression ; Reproductive cycles (rats and human) and their regulations.

Unit II: Early embryonic development 15 periods

Early embryonic development:- Gametogenesis, Spermatogenesis, Oogenesis: Types of eggs, Fertilization; Changes in gametes, Planes and pattern of cleavage; Early development of frog and chick upto gastrulation. Fate maps; Embryonic induction and Organizers.

Unit III: Late embryonic development/Regeneration 15 periods

Late Embryonic development:- Fate of germ layers; Extra embryonic membranes in birds; Implantation of embryo in humans; Placenta (structure, types and functions); Post Embryonic development: Metamorphosis: changes, hormonal regulation in amphibians. Regeneration: Modes of regeneration (epimorphosis and morphallaxis)

Unit IV: Teratogenesis & IVF 15 periods

Implication of developmental Biology: Teratogenesis- teratogenic agents and their effects on embryonic development. In vitro fertilization, stem cell culture, Amniocentesis.

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.

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Semester- VI

Discipline Centric Elective

PISCICULTURE

ZOO-DSE-601

Time: 30 hours

Credits: 2

Max. marks: 50

Unit I: Scope and importance

Scope of Aquaculture. Importance and biology of cultivable fresh water; local and ornamental species.

Unit II: Fish farm management

Fish farm Maintenance- Farm management technique, water quality, temperature and accessories in Farm management viz.-Aerator, Filter, paddler

Unit III: Fish collection techniques

Hatchery facility for cultivable fin fishes, wild collection of seeds, techniques of collection, identification and segregation of seeds, packing, transportation and acclimatization.

Unit IV: Fish feed and Fish Diseases

Feed management, principle of feed preparation, types and different forms of feed, feed ingredient and feed formulation for different cultivable species. Diseases of fishes (common diseases and their control).

Suggested Readings

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

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Semester- VI

Discipline Centric Elective

DAIRY FARMING

ZOO-DSE-602

Time: 30 hours

Credits: 2

Max. marks: 50

Unit I: Dairy development

Live stock in India- related to dairy farming; Introductory animal husbandry- common animal husbandry terms; Dairy development in India, NDDB, NDRI, Dairy Co-operatives. Important cows and buffalo breeds.

Unit II: Management practices

General management practices of Dairy farming- (Grooming Castration, Dehorning, Trimming, Shoeing), Calf management and management of pregnant and lactating Cow and Buffaloes.

Unit III: Milk marketing

Dairy processing: Milk- Composition of milk; factors affecting the quality of milk; milk collection; Pasteurization; grading and packaging; transportation and distribution.

Unit IV: Fodder and Diseases of farm animals

Importance of grassland and fodder in dairy farming. Live stock waste utilization and recycling. Diseases of cattle- Foot and mouth diseases, Anthrax, Haemorrhagic-septicaemia and Babesiasis, Diseases of lactating cow (Mastitis & Milk fever).

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. Taylor, R.E. and Field, T.G. 1977. Scientific Farm animal production.
4. Reddy, D.V. Fodder production and grassland management for Veterinarians.
5. Merkel, J. Managing livestock wastes.
6. Banerjee, G.C. A text book of Animal Husbandry.
7. Jagdish Prasad, Animal Husbandry & dairy science.

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Semester- VI

Discipline Centric Elective

POULTRY FARMING

ZOO-DSE-603

Time: 30 hours

Credits: 2

Max. marks: 50

Unit I: Morphological characters of different varieties

External morphology of Fowls varieties such as Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.

Unit II: Classification and importance

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 III: Feed and Diseases

Poultry feed. Management of egg layers and Broilers in large scale farms. Poultry diseases- Viral, Bacterial, Fungal and Protozoan- their prevention and control.

Unit IV: Management of poultry farm

Management of modern poultry farms; Importance and adverse effects on excessive use of Antibiotics and Growth promoters. Progressive plans to promote poultry as a self-employment venture.

Suggested Readings

Panda, A. K. Rural Poultry production.

Singh, R. K. Handbook of Hatchery technology.

Ibne Ali & Singh, D. K. Handbook of poultry husbandry.

Anand, B. Handbook of poultry disease diagnosis & treatment.

Viyas, M. K. Glimpse of Indian Poultry Industry.

Wilson, Keith. A handbook of poultry practice. (ISBN 8177540697)

Mamdal, A. B., Yadav, A. S., Johari, T. S. & Pathak, N. N. Nutrition & Disease management of Poultry (ISBN 81-8189-075-2)

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Semester- VI

Discipline Centric Elective

AGRO-CHEMICALS AND PEST MANAGEMENT

ZOO-DSE-604

Time: 30 hours

Credits: 2

Max. marks: 50

Unit I: Definition and types of pests

Pest: Definition, pest resurgence, secondary pest outbreak, Economic injury level and Economic threshold; Types of pests according to damage (occasional, perennial).

Unit II: Chemical insecticides

Chemical insecticides: Classification of insecticides: Principles and concept; Organo-chlorine insecticides (DDT and its analogues)- their mode of action and hazards. Organophosphates insecticides-their brief classification mode of action and hazards.

Unit III: Biological control of pests

Biological control: definition principles and concept; successful examples of pest control through biological control agents (predators and Parasitoids). Brief account of Microbial control of insect pests.

Unit IV: Integrated Pest management

Integrated Pest management- Concept and strategies Cultural control (brief account), Genetic manipulation of pest population (Sterile insect release). Hormonal 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.

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Semester- VI

Biostatistics

ZOO-DSE--605

Time: 30 Hours

Credits: 2

Max. Marks: 50

UNIT I

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II

Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT III

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

UNIT IV

Correlation, degree of correlation, Regression, regression coefficient. Emphasis on examples from Biological Sciences.

Suggested Reading:

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield™ 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. A. K. Sharma (2008) A. K. Sharma Vol I & II Discovery Publishing House Pvt. Ltd

Scheme for Five Year Integrated B. Sc., M. Sc. programme in Zoology under CBCS

Semester-VI

Recombinant DNA Technology

ZOO-DSE--606

Time: 30 Hours

Credits: 2

Max. Marks: 50

UNIT I (Tools of genetic engineering)

7 lectures

Restriction modification systems: Types and Nomenclature, restriction maps. DNA modifying enzymes and their Applications like, 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 lectures

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 lectures

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/libraries/applications)

8 lectures

Different methods/approaches 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 (one example each).

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, Twymann 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.
7. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, U.S

Syllabus for Five Year Integrated B. Sc., M. Sc. programme in Zoology under CBCS

Semester- VI

Chemistry option

ZOO-GE-601

Time: 60 hrs

Credits: 4

Max. marks:100

Physical Chemistry II

Unit-I: Thermodynamics-I

15 hours

Thermodynamic functions: State and path functions and their differentials. Thermodynamic processes. Concept of heat and work.

First Laws of thermodynamics: Heat capacity, heat capacities at constant volume and constant pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of ΔU & ΔH for the expansion of ideal and non-ideal (van der Waals) gases under isothermal and adiabatic conditions.

Second law of thermodynamics: Need for the law, Concept of entropy, entropy as a function of V&T, and as a function of P&T. Clausius inequality; entropy as criteria for spontaneity and equilibrium. Entropy change in physical processes, ideal gas expansion and entropy of mixing of ideal gases.

Unit-II: Thermodynamics II

15 hours

Third law of thermodynamics: Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, ΔG & ΔA as criteria for thermodynamic equilibrium and spontaneity their advantage over entropy change. Variation of G and A with P, V and T, Gibbs-Helmholtz equation.

Gibb's free energy: Work function, chemical potential. Definition and relationship between free energy and work function.. Criteria for equilibrium and spontaneous processes. Gibb's-Helmholtz equation-Derivation. Change of free energy with respect to temperature and pressure. Mention of temperature coefficient, van't Hoff isotherm. Derivation of van't Hoff reaction isochore and Clausius-Clapeyron equation, its applications. Qualitative treatment of Nernst heat theorem and III law of thermodynamics-statement only. Elementary concept of residual entropy.

Unit-III: Electrochemistry-I

15 Hours

Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations. Debye-Huckel-Onsager's equation for strong electrolytes. Transport number, definition and determination by Hittorf's and moving boundary methods. Application of conductivity measurements: determination of degree of dissociation and dissociation constants of acids, solubility product of a sparingly soluble salt, conductometric titrations.

Unit-IV: Electrochemistry-II

15 Hours

Types of reversible electrodes (half-cells): metal-metal ion, gas-metal-ion, metal-insoluble salt- anion and redox electrodes. Standard hydrogen electrode, glass electrode, reference electrodes (calomel, Ag/AgCl) . Electrode reactions, Nernst equation and cell E.M.F. Electrochemical series and its significance. Electrolytic and Galvanic cells. Measurement of EMF of a cell. Concentration cells, electrolyte concentration cell (with and without transport), electrode concentration cell. Application of standard potentials: determination of thermodynamic functions of cell reactions (ΔG , ΔH and K .), pH and pKa, solubility product and activity coefficient; potentiometric titrations.

Books Recommended:

1. *The Elements of Physical Chemistry*; P. W. Atkins; Oxford.
2. *Physical Chemistry*; G. M. Barrow; McGraw-Hill; International Student edition.
3. *Physical Chemistry*; R. A. Alberty; Wiley, Eastern Ltd.
4. *Essentials of Physical Chemistry Vols III & IV*; K. L. Kapoor ;Macmillan India Ltd.
5. *Principals of Physical Chemistry*; Puri, Sharma and Pathania ; S. Nagin Chand &Co.
6. *Physical Chemistry through Problems*; S. K. Dogra ; Wiley Eastern Ltd.
7. *University general Chemistry*; C. N. R. Rao; MacMillan.
8. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press.
9. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
10. Engel, T. & Reid, P. *Thermodynamics, Statistical Thermodynamics, & Kinetics* Pearson Education, Inc: New Delhi (2007).
11. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).

Lab course

Credit: 2

ZOO-GE-602

Max Marks: 50

1. pH metric titrations of i)strong acid and strong base (ii) weak acid and strong base
2. Determination of the composition of a mixture of HCl and CH₃COOH by titration with standard NaOH.
3. Determination of degree of dissociation of a weak acid.
4. Determination of strength of an acid by titration with an alkali using quinhydrone electrode. 2. Titration of Fe (II) vs K₂Cr₂O₇ and determination of standard redox potential of Fe²⁺/Fe³⁺.
5. Determination of refractive index of some liquids and finding the composition of a binary liquid mixture by refractivity method.
6. Determination of heat of neutralisation of a strong acid with a strong base.
7. Determination of heat of neutralisation of a weak acid with a strong base.

Books Recommended:

1. Practical Physical Chemistry, Findley, Kitchener, Longman, 1977. 2. Advanced Practical
2. Physical Chemistry, Yadav, Goel Pub, 1994.

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Semester-VI

Botany option

Plant Biotechnology and conservation

ZOO-GE-603

Credit: 4

Max marks:100

Unit 1:

Basic concepts in Plant Tissue Culture Basics terms and definitions in plant tissue culture; Introduction to in vitro cultures; Laboratory set up; Sterilization techniques; Media: Various kinds of media, Composition and significance of media components; Plant growth regulators; Micropropagation: Axillary bud, Shoot tip, Meristem culture

Unit 2:

Types of Plant Tissue Culture Introduction to organogenesis, Production of haploid plants and their applications ; Ovary and ovule culture, In vitro pollination and fertilization, Pollen culture, Anther culture, Embryo culture: History and methodology, Embryo rescue after wide hybridization, Applications, Somatic embryogenesis

Unit 3:

Types of Plant Tissue Culture Endosperm culture and production of triploids, Single cell suspension cultures, Mutant Selection, Scale up of cell cultures and bioreactors, Protoplast isolation and culture, DNA transformation methods in plants

Unit 4:

Applications Somaclonal variation and applications, Somatic Hybridization and its applications, Virus free plants, Germplasm conservation, Synthetic seeds, Applications of plant DNA transformation. Hairy root culture, Secondary metabolite production, Transgenics in crop improvement, Plant Proteomics

Suggested Readings:

1. Plant Tissue Culture, Theory and Practice, Rev Ed., S. S. Bhojwani, M.K. Razdan
2. Biotechnology, B.D. Singh
3. Introduction to Plant Biotechnology, 3rd Ed., H. S. Chawla
4. Plant Tissue Culture, development and Biotechnology, Edited by Robert N. Trigiano and Dennis J Gray.
5. Plant Propagation: Principles and Practices – Hartmann, H.T and Kester D. E. 6. Introduction to Practical Biochemistry. T. Plumm

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Laboratory Course

ZOO-GE-604

Credit: 2

Max Marks: 50

1. Study of laboratory equipments
2. Stocks and Media preparation
3. Sterilization techniques in plant tissue culture
4. Explant selection, treatment and inoculation
5. Subculture of initiated cultures
6. Acclimatization of cultures
7. Extraction of proteins from plants and its estimation
8. Extraction of DNA/RNA from plants and its estimation
9. Estimation of peroxidase activity in plants
10. Study of β – amylase enzyme from germinated pulses

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Semester-VI

Skill Enhancement Course

Herbal Medicine

ZOO-SEC-601

Credit: 2

Max. marks: 50

Time: 30 Hours

Unit I Concept and prospects of Herbal Medicine

History of traditional herbal medicines, role of herbal medicine in traditional healing. Status of herbal medicine in India, efficacy of herbal medicines. Future prospects of herbal medicine.

Unit II Herbal Preparations

Enextracted herb forms: extracted herbs and herb products. Tincture strength, Decoctions, essential oils, herb vinegar, ointments. Preparations of homeopathic and Batch flower medicine dilutions. Herbal tea(s).

Unit III Common medicinal plants of India

Fruit – Amla, Bulb – Garlic, Rhizome – Ginger, seed – castor, flex Bark – Cinchona, Leaves – Neem, mint , Flower – Clove, Brahmi (*Bacopa monnieri*) and Saffron (*Crocus sativus*).

Unit IV Some useful plants in modern medicine

Health benefits and uses of *Catharanthus roseus*, *Saussurea costus*, *Arnebia benthami*, *Fritillaria roylei*, *Tribulus terrestris*, *Aconitum heterophyllum*, *Digitalis purpurea*, *Indigofera heterantha*, *Atropa acuminata*, *Withania somnifera*, *Aloe vera*, *Ocimum sanctum*

Suggested Readings:

1. Panda, H. 2004. Handbook of Herbal Medicine.
2. Panda, H. 2004. Handbook of Herbal drugs and its plant source.
3. Khare, C.P. 2004. Indian Herbal remedies- Rational Western therapy, Ayurvedic and other usage, Botany, Springer.

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Semester-VI

Skill Enhancement Course

APICULTURE

ZOO-SEC-602

Time: 30 hours

Credits: 02

Marks: 30

Unit 1: Biology of Bees & Classification

Biology and classification of honey bee species. Social organization in honey bees. Different species of honey bees used in honey production.

Unit II: Requirements for Apiculture

Bee hive structure and temperature regulation. Methods of bee keeping- Indigenous methods of extraction of honey. Flora for Apiculture-selection of bees for Apiculture.

UNIT III: Methods, Appliances and Honey bee diseases

Modern methods of Apiculture- Appliances for modern method. Diseases and control of honey bee diseases.

Unit IV: Products of Honey bee

Bee enemies, Products of bee keeping-Honey (chemical composition). Economic importance of honey bee wax.

NOTE: Visit to

Apiary. 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.

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Semester-VI

Skill Enhancement Course

AQUACULTURE

ZOO-SEC-603

Time: 30 hours

Credits: 02

Marks: 30

Unit I: Principles of Aquaculture

Basics of aquaculture, definition and scope. History of aquaculture. Systems of aquaculture- pond culture and running water culture. Monoculture, Polyculture and Integrated culture system.

Unit II: Freshwater Aquaculture

Freshwater Aquaculture resources- ponds and lakes. Control of aquatic weeds and Algal blooms. Water quality management. Culture to Carp, prawn and mussels- brief general account.

Unit III: Ornamental fish production

World trade of ornamental fish and its export potential. Different varieties of exotic and indigenous fishes. Principle of balanced aquarium, setting up and maintenance of fresh water aquarium.

Unit IV: Coastal aquaculture

An overview of sea farming and shore based aquarium. Introduction to culture of shellfish. General account of Pearl culture its requirements, methods and uses. Resources for shore-based aquaculture and sea Farming in India.

Suggested Readings:

1. N Arumugam (2014) Aquaculture and Fisheries, Saras Publication.
2. B. Ahilian (2011) Integrated Aquaculture, Dayal Publishing House.
3. R. K. Rath (2011) Freshwater Aquaculture, Scientific Publishers Journals.

Semester VII
Biosystematics

ZOO-CC-701
Credits: 04

Time: 60 Hours
Max. Marks: 100

Unit-I: Taxonomic Procedure

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 Publication

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 publication; methods of preparation of taxonomic keys; Articles of ICZN regarding date of publication, validity of names (family-group, Genus-group & species-group), Homonymy.

Unit-III: Modes of Speciation

Allopatric & Sympatric speciation- factors, methods and their evolutionary significance; Parapatric and Stasipatric speciations (Definitions and examples). Effects of Geography and Ecology in speciation. The founder principle, bottleneck effect and genetic drift in speciation.

Unit-IV: Newer Trends

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 Bar coding; Taxonomic significance of C value and C value paradox.

Suggested Readings:

1. EarnstMayr, 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. Simposon, G.G.1961. Principles of Animal Taxonomy

Semester VII

Animal: Structure and Function

ZOO-CC-702

Credits: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Locomotion and Feeding in invertebrates

Amoeboid and fibrillar movements (Theories of amoeboid movement and types of amoeboid cells); characteristics of ciliary movements; fibrils (microfilaments and microtubules); factors affecting amoeboid and ciliary activity; principles of hydrostatic skeleton in locomotion; significance of coelom in locomotion; mechanism of food intake (ingestion of soluble food, particulate food and food masses in relation to habit and habitat); symbiotic nutrition; food selection and its regulation.

Unit-II: Body fluids, Circulation and Respiration in invertebrates

Intracellular transport in protozoa; circulation in external medium of transport within the body of sponges and coelenterates; blood vascular system in invertebrates (open and closed); types, physiology of blood of blood pigments in annelids and insects; structure of heart in annelids and insects – neurogenic and myogenic heart; respiratory organs in invertebrates (Arthropods).

Unit-III: Excretion and Osmoregulation

Excretory organs in arthropods and vertebrates; Ammonotelic, ureotelic and uricotelic vertebrates; urine formation, method of urea formation (Ornithine cycle); mechanism of uric acid formation; osmoregulation, isotonic, hypotonic and hypertonic vertebrates; animal response to osmotic condition of the medium; euryhaline and stenohaline animals; osmoregulation in fresh water, marine and brackish water vertebrates.

Unit-IV: General Organization and Adaptive Radiation of Animals

Larval forms of Crustacea, Insect, Mollusca and Echinodermata; General characters of Ectoprocta and Endoprocta; General account of origin and evolution of vertebrates; Ostracoderms and evolution of fishes; Origin and evolution of amphibians, reptiles, birds and mammals. Adaptive radiation in mammals (Aquatic and Volant)

Suggested Readings:

1. Barnes, R.D. 1968. Invertebrate Zoology (Saunders).
2. Barrington, E.J.W. 1979. Invertebrate structure and Function (Boston-Houghton, Mifflin)
3. Hyman, L.H. The Invertebrates. Vol. I to VI.
4. Young, J.Z. The life of Vertebrates (OUP NY)
5. Goodrich: Structure and development of Vertebrates, vol. I & II (Reprint Dover Publ).

Semester VII

Animal Behavior

ZOO-CC-703

Credit: 04

Time: 60 Hours

Max. Marks:100

Unit-I: Ethology, Social and Reproductive Behaviour

Introduction: Ethology as a branch of Biology, Neural and Hormonal control of behavior, patterns and objectives of behavior, Ethogram, Sexual Selection, Seasonality, Monogamy, Polygamy, Polyandry, Courtship, Persuasion, Appeasement, costs and benefits of group living, Eusociality, Reflexes, types of reflexes, reflex action, reflex arch, complex behavior, Inclusive fitness. Fisher's theory of runaway sexual selection, Handicap principle, Homeostasis and behavior, Leks and Harems, Navigation and disposal, Herding in mammals, Flocking in Birds, Orientation-Primary and secondary, Lunar orientation, Sun compass orientation.

Unit-II: Territoriality, Aggression, Learning and Conflict Behaviour

Ecological aspects of behavior, Habitat selection, Optimal Foraging theory, Aggression, Foraging, crowding, territorial conflicts, Pure attack and escape, Threat displays, Types of Learning, Programmed learning, Imprinting, Habituation, Sensitization, reasoning, Classical conditioning, Instrumental conditioning, Active learning, Escape learning, Insight Learning, Latent Learning, Song learning, Intra sexual selection (male rivalry), Inter sexual selection (female choice)

Unit-III: Motivation and Social Organization

Concept of Motivation, Physiological basis of motivation, Drive, Timing and Interaction of drives, Measuring motivation, Models, control of hunger drive in Bowfly, Lorenz's model, Deutsch's model, Kinesis, Altruism, Aggression, Reciprocal Altruism, Kin selection Hypothesis, Alarm calls, Orthokinesis, Klinokinesis, Taxes, Types of taxes, Motivation in Guppies, smooth newts, Rhesus Monkeys, Neurophysiology of Motivation, Homing, Migration in Fishes, Turtles and Birds, Social Organization in Insects, primates and honey bees, Polyphenism and its neural control, Flower recognition, Defensive behavior in insects

Unit-IV: Biological Clocks, Communication and Anti-predator Behavior

Biological Rhythms, Types of Rhythms, Circadian Rhythms, Circannular rhythms, Tidal rhythms, Hibernation, Interspecific Territoriality, Diurnality, Echolocation, Crypsis, Form of signals, Communication-chemical, visual, light and audio, Electoreceptors for communication, Recognition, Deme recognition, Kin recognition, Bioluminescence, Electrolocation, Code breakers, Fixed Action Plan (FAP), Feeding strategies, Group defense, Schooling in fishes, Reflexes and complex behavior.

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 Behaviour, A. Manning and M.S. Dawkins, Cambridge University Press, UK

Semester VII
Laboratory Course

ZOO-CC-704

Credit: 04

Time:60 Hours

Max. Marks: 100

1. Locomotor organs: Preparation of live amoebae, ciliates and flagellates mount to observe, pseudopodial, ciliary and flagellar movements (use mild narcotizing agents).
2. Observations on the movements of setae in Earthworm
3. Observations on the structure and working jointed legs of Insects and Crustaceans.
4. Observations of feeding in Insects (study of mandibulate, piercing and sucking, lapping, siphoning and sponging type mouthparts).
5. Qualitative demonstration of Ptyalin/any other available enzyme.
6. Study of Respiratory organs in Crustacean and Insects.
7. Structure of gills in Teleosts and Elamobranh fishes.
8. Study of Blood cells of any chordate (fish and pigeon)
9. Study of Nephridia of Earthworms through permanent slides.
10. Study of Cranial nerves of Fishes.
11. To study geotaxis behavior of earthworm
12. To study locomotion and feeding of Snails
13. To study locomotion, web construction and prey capture in Spiders,
14. Rolling behavior of domestic cats
15. Identification of Amphibian and Reptiles through taxonomic keys.
16. Social organization in honey bees and ants
17. Observation on the territoriality behavior of dogs.

Semester VII
General Entomology

ZOO-DSE-701
Credits: 02

Time: 30 Hours
Max. Marks:50

Unit-I: Insect Classification/Apterygotes & Exopterygotes

Detailed classification of Apterygote orders upto family level: Collembola, Protura, Diplura and Thysanura. Classification upto family level of exopterygote insect order viz., Odonota, Ephemeropter, Orthoptera, Dictyoptera, Thysanoptera, Isoptera, Hemiptera (Homoptera/Heteroptera), Siphunculata and Mallophaga.

Unit-II: Classification of Endopterygote Insects

Classification of Diptera upto suborder and family level with the emphasis of economically important families. Classification of Lepidoptera, Coleoptera and Hymenoptera upto suborder level wherever necessary and with special reference to economically important families.

Unit-III: Insect Morphology

Insect Integument its structure and composition. Head- types of mouthparts and their modifications. Thorax- structure; Wings- structure and modifications. Legs- structure and modifications.

Unit-IV: Insect Development

Embryonic development- Early and Late. Insect larval forms (compodeiform, vermiform, Scarabaeiform larvae) and their characteristic features. Insect pupae (Exarate, Obtect, Coarctate & Chrysalis).

Suggested Readings:

1. Gillot, C. Entomology, Springer Netherland.
2. Chapman, R.F. The Insects-Structure & Function (The Eng. Language book Sc.)
3. Gullan, P.J. & Cranston, P.S. The Insects: An outline of Entomology (Blackwell Science)
4. Johnson, N.F., Borror & DeLong's Introduction to the study of Insects (Books Cole)
5. Ross, H.H., Ross, C.A. & Ross, J.R.P. A text book of Entomology (John Wiley & sons)
6. Richards, A.D. & Davies, O.W. Imm's General text book of Entomology (2 vols).
7. Sondgrass, R.E. Principles of Insect Morphology. Ithaca, USA

Semester VII
Laboratory Course

ZOO-DSE-702
Credits: 02

Time: 30 Hours
Max. Marks:50

1. Taxonomy and Identification of economically important families of the following orders: Collembola, Thysanura, Odonata, Ephemeroptera, Orthoptera, Dictyoptera, Thysanoptera, Isoptera, Homoptera, Heteroptera, Siphunculata, Mallophaga, Diptera, Coleoptera, Lepidoptera, Hymenoptera.
2. Studies of different developmental stages (Nymphs, Naiads, Larva, pupa etc) of Grasshoppers, Odonata, Cockroach, Coleoptera, Lepidoptera, Diptera.
3. Preparation of whole mount of small insects-Aphids, Head louse, Bird louse, Thrips etc.
4. Temporary mount preparations of Antennae, wings, legs, pretarsus, Halteres, mouthparts & genitalia of Grasshoppers, Dragonfly, Housefly, mosquitoes, Honey bee.
5. Experiment to demonstrate the presence of Chitin in the insect integument.
6. Principle and working of different Microscopes.
7. Camera lucida drawing.
8. Photomicrography techniques in Entomology.

Semester VII

General Parasitology

Course Code: ZOO-DSE-703

Credits: 02

Time: 30 Hours

Max. Marks: 50

Unit-I: Parasites of Veterinary Importance

Morphology, life cycle, pathogenicity and control of: **Protozoa:** *Toxoplasma*, *Eimeria* **Trematoda:** *Paramphistomum cervi*; **Cestoda:** *Taenia saginata*, *Moneizia expansa*, **Nematoda:** *Ascaridia galli*, **Acanthocephala:** *Pomphorynchus laevis*.

Unit-II: Parasites of Medical Importance

Morphology, life cycle, pathogenicity and control of: **Protozoa:** *Trypanosoma*; **Trematoda:** *Paragonamus westermani*, **Cestoda:** *Diphyllobothrium latum*, **Nematoda:** *Strongyloides stercoralis*, *Loa loa*.

Unit-III: Physiology and Nutrition of Parasites

Feeding and nutritional physiology: The alimentary canal of monogenea, digenea and the role of external surfaces of parasites in their nutrition, trans-integumentary absorption of nutrients; surface enzymes in parasites, Carbohydrate metabolism and energy production in parasites.

Unit-IV: Ecological Perspective of Parasitology

Distribution of parasites and their hosts, micro distribution, Geographical variation, Morphological adaptation (degeneration and specializations/neoformations) and Physiological adaptations in parasites. Host-Parasitic interaction in relation to environment. Parasites as ecological indicators and monitors of environmental health. Host Parasitic strategies (Effect of parasite on host and effect of host on parasite).

Suggested Readings:

1. Kindt, T J; Goldsby, R A & Osborne, B A. 2007. Kuby Immunology. 6th Ed. WH Freeman.
2. Male, D.; Brostoff, J.; Roth, D B & Roitts, I. 2007. Immunology. 7th Ed. Mosby Elsevier.
3. Tizard, I R. 2004. Veterinary Immunology: An Introduction. 7th Ed. Saunders/Elsevier.
4. Detrick, B & Hamilton, R G. (Eds). 2006. Manual of Molecular and Clinical Laboratory Immunology. 7th Ed. American Society for Microbiology.
5. Rose, N R; Friedman, H & Fahey, J L. (Eds). 1986. Manual of Clinical Laboratory Immunology. American Society for Microbiology.
6. Weir, DM. 1986. Handbook of Experimental Immunology. Vol. IV. Blackwell.
7. Chowdhury, N. and Toda, I. 1994. *Helminthology*. Springer Verlag, Narosa Publishing House.

Semester VII

Laboratory Course

Course Code: ZOO-DSE-704

Credits: 02

Time: 30 Hours

Max. Marks: 50

1. Principle and working of different microscopes.
2. Stage Micrometer method of micrometry (Camera Lucida Method).
3. Stage and Occular micrometer method of Micrometry.
4. Photomicrography techniques in Parasitology.
5. Specimen study of the following parasites through permanent preparations: *Clonorchis sinensis*, *Paragonamus westermani*, *Clinostomum* spp., *Paramphistome cervi*, *Echinococcus granulosus*, *Hymenolepis nana*, *Fasciolopsis buski*, *Pomphorhynchus kashmirensis*.
6. Paraffin Wax method of microtomy for helminthes.
7. Double staining method of permanent preparation of protozoans.
8. Qualitative Estimation of total carbohydrates and total proteins of helminth parasites by standard biochemical methods. Separation and estimation of molecular mass of helminth protein by SDS PAGE
9. Diagnosis of parasites of veterinary importance by coprological techniques

Semester VII

Fish Classification and Structures

ZOO-DSE-705

Credits: 02

Time: 30 Hours

Max Marks: 50

Unit- I: General Classification and Evolution of Fishes

Outline Classification of Fishes, Distinctive Features, Geographical Distributions, Classification and typical examples of the following Subdivisions, Elasmobranchi, Holocephali, Dipnoi, Actinopterygi, Crossopterygi, Sarcopterygii and Evolution of Fishes.

Unit II: Taxonomy of Important Teleosts

Taxonomic Study of the Marine and Freshwater Teleosts with special reference to following orders Clupeiformes, Scopeliformes, Perciformes, Cypriniformes, Ophiocephaliformes, Cyprinodontiformes, Syngnathiformes, Beloniformes, Anguilliformes, Lophiformes and Tetradontiformes.

Unit-III: Fish Locomotion and Sense Organs

Methods of Locomotion in Fishes, Types and Mode of Locomotion, Role of Fins in Locomotion, Origin of Paired fin, Structure, Skeletal support, Modification and Functions of Paired and Unpaired Fins, Types of Caudal Fin; Sense Organs; Eyes, Lateral Line System and Ampullae of Lorenzini

Unit-IV: Skin Derivatives and Special Features

Skin, Structure and Function; Scales, Type, Structure and Function of Scales; Coloration, Chromatophores, Pigments and Biological Significance of Coloration in Fishes; Weberian Ossicle, Structure, Origin, Working and Function; Electric Organs; Structure and Uses in Fishes, Bioluminescence in fishes and its significance.

Suggested Readings:

1. Berg. L.S. 1947. Classification of fishes. Both recent and fossil, 1.M. Edwards, Alm, AI-bor, Michigan
2. Vasanth Kumar, Daya Publ. House, New Delhi. 2013. Advancers in Aquatic Ecology
3. Arvind Kumar and Pushaplata Dubey. Daya Publ. House, Delhi. 2006. Fish Management and Aquatic Environment
4. Lagler, Bardock, Miller & Possino, John Wiley & Sons, N.Y., London: 2012. Ichthyology, 2nd Ed.

Semester VII
Laboratory Course

ZOO-DSE-706
Credits: 02

Time: 30 Hours
Max Marks: 50

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 Lateral Line System in Fishes
 4. Study of Structure of Ampullae of Lorenzini in Scoliodon
 5. Study of Structure of Weberian Ossicle in Fish.
 6. Study of Chromatophores in Fishes.
- Any other practical found feasible by the teacher

Semester VII
Nutrition & Health
ZOO-OGE-701
Credits: 04

Time: 60 Hours
Maximum Marks: 100

Unit I. Human Nutrition

Concept and Definition of Terms-Nutrition, Malnutrition and Health; Influence of Nutrition on Human Health; Food, Classification of Food; Classification of Nutrients; Nutritional Deficiencies: (Protein Calorie Malnutrition, Vitamin and Mineral Deficiencies; Therapeutic Diet/Diet Therapy, Dietary Management of Diseases; Nutritional Intervention Programmes to Combat Malnutrition: Role of ICDS, Significance of Mid Day Meal Programme in Combating Malnutrition in School Children.

Unit II. Public Health Diseases and Their Prevention

Communicable Diseases: Polio, Hepatitis, Rabies, AIDS; Non – Communicable Diseases/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

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

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.

References (Books)

1. Park's Textbook of Preventive and Social Medicine, 23rd Edition .
2. Sunder 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 Paperback – 30 Jun 2012 by Sunetra Roday .
5. 5. Gopalon. C.; Nutrition Foundation of India, Special Publication service.
6. 6. Beghin, I. Cap. M: Dujardan. B. : A Guide to Nutrition Status Assessment. W. H. O. Geneva.

Semester VIII

Inheritance Biology

ZOO-CC-801

Credit: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Basic Genetics

Genetics – definition, history and scope; genomic imprinting; penetrance and expressivity; phenocopy; extra -chromosomal inheritance; polygenic inheritance; heritability and its measure; QTL mapping; nature of the gene and its functions; fine structure of gene (rII locus); pedigree analysis; Genetics and molecular basis of cell cycle (cell cycle check points, cdk's); Linkage maps; tetrad analysis in Neurospora.

Unit-II: Developmental Genetics

Model organisms for the genetic analysis of development; differential gene expression during development; sex determination and dosage compensation in mammals and *Drosophila*; mosaic and regulative development for cell determination; *Drosophila* – Life stages, genetic mechanism patterning the *drosophila* body, segmentation of the anterior posterior body plan, segmentation genes, homeotic selector genes, generating the dorso-ventral axis, Axes and organ primordia, The Cartesian Coordinate Model; *Coenorhabditis elegans* – antero-posterior, dorsolateral and right-left axes formation.

Unit-III: Cancer Genetics: Diagnosis and Management

Characteristic features of normal and cancerous cells; types and classification; metabolism of cancer cells: Angiogenesis, invasion and metastasis; cancer genes (tumor suppressor genes, proto-oncogenes, oncogenes and apoptotic genes); cellular roles of tumour suppressor proteins (pRB, p53, pAPC, pBRCA-1); telomere, telomerase and onset of cancer; Prevention of cancer: nutrition, healthy life style, medicine and other pathways.

Unit-IV: Applied Genetics

Genetically engineered bacteria for production of vaccines, interferons, growth hormones, monoclonal antibodies and other products for use in human health care; Transgenic plants – herbicide resistance and insect resistance, Agrobacterium mediated gene transfer; Transgenic animals – Mice, cattle, goat, sheep and fish, Knockout mice and Cre/ lox system. Vectors for gene transfer in animals, embryonic stem cell transfer; Gene therapy; DNA fingerprinting; Prenatal diagnostic techniques – Amniocentesis, ultrasonography, chorionic villus sampling; Genetic counselling and ethical issues; ill effects of consanguineous marriages. Stem cells and regenerative medicine.

Suggested Readings

1. The Science of Genetics – Atherly, Girton & McDonald, Saunders College Publishing
2. Genetics – A Molecular Approach - Peter J. Russel, 3rd Ed., Pearson
3. The Cell - Cooper & Hausman, 6th Ed., Sinauer Associates, Inc., Publishers
4. Developmental Biology - Gilbert & Barresi, 11th Ed., Sinauer Associates, Inc., Publishers
5. Introduction to the Cellular and Molecular Biology of Cancer - L.M. Franks
6. Biotechnology - B.D. Singh, 3rd Ed., Kalyani

Semester VIII

Evolutionary Biology

ZOO-CC-802

Credit: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Emergence of Evolutionary thoughts

Emergence of Classical, Medieval, Pre Darwinian and Darwinian revolution; Overview of major evolutionary theories with emphasis on advanced evolutionary theories: Genetic (synthetic) theory of evolution, "Out of Africa" theory or recent African origin model (RAO), Neutral Evolution and its mechanism.

Unit-II: Origin of Cells and Unicellular Evolution

Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Symbiogenesis or endosymbiotic theory, Secondary endosymbiogenesis; The RNA world hypothesis and origin of life

Unit-III: Paleontology and Evolutionary History

Formation of fossils and reconstruction of evolutionary history, Microfossils and their relevance with relation to evolutionary history, Explosion in the evolution of life on Earth; The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Zoogeographical realms and their origin; Stages in primate evolution including Homo and Horse.

Unit-IV: Molecular Evolution & Evolutionary Mechanisms

Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Introduction to Evolutionary Computation, Types of phylogenetic trees and networks: Coding characters and defining homology, Morphological analysis, Molecular analysis.

Suggested Readings:

1. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
2. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
3. Genes in Population by Spiess. E (1989) 2nd Edition. Wiley-Liss, New York.

Semester VIII

Advanced Developmental Biology

ZOO-CC-803

Credit: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Basic Concepts of Developmental Biology

General Concept of Competence and Induction, Lens and Neural induction in Vertebrates, Cell differentiation, types, chemical basis of differentiation Cell commitment and determination, 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.

Unit-II: Mechanism of Gametes Fusion

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; Mechanism and regulation of ovulation, Structure of egg and sperm, Translocation of gametes and capacitation, Thermotaxis and chemotaxis for sperm attraction, Recognition at the Zona pellucida, Gamete fusion and Prevention of polyspermy.

Unit-III: Embryonic Development and Sex determination

Primary Axis formation in *Drosophila* during oogenesis, Anterior-posterior polarity of oocytes, Dorsal-ventral patterning in the oocytes, Protein gradient in early embryo, Progressive determination and molecular mechanism of Amphibian axis formation, Formation of limb bud in tetrapod, Generating the Proximal-Distal axis, anterior-posterior axis and dorsal ventral axis of limb. Hormonal and Environmental Sex determination in vertebrates, Sex determination in humans

Unit-IV: Chick Embryology

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

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.

Semester VIII

Laboratory Course

ZOO-CC-804

Credit: 04

Time: 60 Hours

Max. Marks: 100

1. Study of fruit fly and its red and white eye character following a cross.
2. Isolation and study of giant chromosomes of Chironomous larva.
3. Preparation of pedigree analysis.
4. Identification of female and male drosophila
5. Preparation of feed medium for fruit flies
6. Chick - Study of developmental stages - primitive streak, 21h, 24h, 28h, 33h, 36h, 48h, 72h, 96h (H.H. stages) by raising chick embryo in the laboratory.
7. Construction of Phylogenetic trees and interpretation of results.
8. Study of Human chromosomes through permanent preparation
9. Study of life cycle stages of Drosophila
10. Study of the Mendelian traits.
11. To study the human Barr Body.
12. Study of different types of eggs with reference to yolk content.
13. Observations on the effect of Vitamin A palmitate/retenoic acid on limb development in frog, tadpole.
14. Observations on structure of egg in Drosophila.

Semester VIII

Insect Ecology, Anatomy & Physiology

ZOO-DSE-801

Credits: 02

Time: 30 Hours

Max. Marks:50

Unit-I: Insect Ecology

Fundamentals of Insect Ecology; Abiotic factors (temperature, Light & Humidity) and their effects on the biological activities of insects. Inter and Intra-specific competition. Insect plant inter-action and its evolutionary significance. Diapause and Cold Hardiness in insects.

Unit-II. Insect Anatomy- I

Digestive system- structure of alimentary canal and its modifications. Origin of Fore, mid and hind guts; mouthparts in insects- basic types; salivary glands and their modifications. Excretory organs- structure of Malpighian tubules; sound and light producing organs.

Unit-III. Insect Anatomy- II

Nervous system- structure and its modifications, neurosecretory cells and their role; respiratory system structure and modifications; circulatory system- structure; structure of male and female Reproductive organs and associated glands.

Unit-IV. Insect Physiology

Physiology of digestion- digestive glands and their secretions, role of peritrophic membrane; Physiology of Excretion and Respiration. Composition of Haemolymph and functions of different types of cells.

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)
7. Wigglesworth, Insect Physiology.

Semester VIII
Laboratory Course

ZOO-DSE-802
Credits: 02

Time: 30 Hours
Max. Marks:50

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. Exercise to study the response of light in Housefly.
6. Exercise to determine moisture contents of insects

Semester VIII

Plant Nematology and Parasitic Resistance

Course Code: ZOO-DSE-803

Credits: 02

Time: 30 Hours

Max. Marks: 50

Unit-I: Nematode Taxonomy and Morphology

General morphology of plant parasitic nematodes. Classification of nematodes by habitat and economic importance: i) Above ground feeders (feeding on flower bud, leaves and bulbs) ii) Below ground feeders: a) Endo-parasitic nematode (migratory and sedentary), b) Semi-endoparasitic and c) Ectoparasitic (migratory and sedentary).

Unit-II: History, Economic Importance and Ecology

Morphology and economic importance of Root Knot Nematode: *Meloidogyne incognita*, *Heterodera schachtii*, *Xiphinema* sp., *Ditylenchus* sp., *Tylachulus emipenetrans*; *Raodopholus similes*. Free living soil nematodes and their role in recycling of nutrients in the environment.

Unit-III: Plant Nematode Relationship and Management

Nature of damage caused by various groups of plant parasitic nematodes and mechanism involved in case of cyst forming nematodes, lesion nematodes and burrowing nematodes. Control and management of plant parasitic nematodes by cultural and biological methods.

Unit-IV: Climate Change and Parasitism

General overview of impact of climate change on parasitic diseases, Effect of Climate change on major human diseases: Malaria, Dengue, Tick Borne Encephalitis (TBE), Babesiosis. Impact of climate change on the parasitic diseases of small ruminants / man. General overview of disease modelling. Remote sensing (RS) and geographic information system (GIS) as tool for mapping parasitic diseases.

Suggested Readings:

1. Williams, H. & Jones, A. (1994) Parasitic worms of fish. 593 pp. London, Taylor & Francis.
2. Introduction to Plant-Parasitic Nematodes.
<https://www.apsnet.org/edcenter/intropp/PathogenGroups/Pages/IntroNematodes.aspx>
3. Zuckerman, B.M. And Rohde, R.A. (1981) Plant Parasitic Nematodes.
4. Stirling, G. (2014) Biological Control of Plant-parasitic Nematodes. Biological Crop Protection Pty. Ltd, Australia.

Semester VIII

Laboratory Course

Course Code: ZOO-DSE-804

Credits: 02

Time: 30 Hours

Max. Marks: 50

1. Collection of soil samples for the extraction of plant parasitic nematodes from different habitats
2. Extraction of nematodes from soil and root-samples by Bayerman's funnel methods.
3. Cobb's sieving method for extraction of Plant parasitic nematodes.
4. Temporary preparation of plant parasitic nematodes.
5. Permanent preparation of plant parasitic nematodes.
6. Demonstration of Plant parasitic nematodes through permanent slides.
7. Measurement of parasite species richness, diversity index, infection indices: Measurement of species richness and diversity index, The Jaccard coefficient of community similarity (CCj), Sorenson's index (Si)
8. Mini project work: Protocol for measuring parasite biodiversity-parasites of fishes /sheepparasites.

Semester VIII

Fish Physiology and Ecology

ZOO-DSE-805

Credits: 02

Time: 30 Hours

Max Marks: 50

Unit-I: Feeding and Respiration

Alimentary Canal and its diversity in Fishes, Food, feeding habits and Feeding Adaptations, Respiratory Organs; Structure, Modifications and Functions of Gills, Mechanism of Gill Respiration, Structure and Development of Air Breathing Organs in Fishes, Structure and Function of Swim Bladder.

Unit-II: Circulatory and Excretions

Structure of Heart; Afferent and Efferent Branchial Vessels in *Scoliodon* and *Labeo*; 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-III: Reproduction and Development

Reproductive Organs and Accessory Sex Organs, Maturation and Spawning, Seasonal changes and Gonado-Somatic Index (GSI), Secondary Sexual Characters, Hormonal Regulation of Fish Reproduction, Oviparous, Viviparous and Ovoviviparous Fishes, Types of Eggs, Development up to Gastrulation, Hatching, Metamorphosis, Nest Building and Parental Care. Sex determination in fishes, Hybridization, Gynogenesis and Androgenesis

Unit-IV: Fish Population, Growth and Age

Fish Population; Structure and Methods of Estimation, Population Dynamics and Factor effecting Fish Population; Growth; Methods for the Measurement of Growth, Length-Weight Relationship, Growth Rates, Age Determination 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

Semester VIII
Laboratory Course

ZOO-DSE-806

Time: 30 Hours

Credits: 02

Max Marks: 50

1. Study the internal anatomy of fish
 - (i) Alimentary Canal
 - (ii) Structure of gills and Swim bladder
 - (iii) Circulatory system
 - (iv) Reproductive system
 2. Study of Accessory Respiratory Organs in fishes.
 3. Biological analysis of fish samples for gut content to study feeding habits
 4. Determination of age in fishes using scales
 5. Calculation of gonadosomatic index for given fish specimen and its significance.
- Any other practical found feasible by the teacher

ZOO-OGE-801
Credits: 04

Semester VIII
Ornamental Fisheries

Time: 60 Hours
Maximum Marks: 100

UNIT-I Introduction to Ornamental Fisheries and Ornamental Fish Trade

- Basics of 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.
- Ornamental fisheries-A new dimensions in aquaculture entrepreneurship.

UNIT- II Introduction to Ornamental fishes and plants

- Basic knowledge of ornamental fishes in world /Kashmir
Basic characteristic features of Ornamental fishes
- Basic knowledge and profile of some selected indigenous Indian ornamental Fishes.
- Introduction to Aquarium plants and their export potential.
- Aquarium plant propagation.
- Management of ornamental aquatic plants and its trading.
Challenges and opportunities of aquarium fisheries in Kashmir valley.

UNIT-III Aquarium designing and associated equipments

- Design Construction, settings and maintenance of aquarium (fresh water and marine aquaria).
Introduction to aquarium and aquarium accessories
- Aerators, filters and lighting.
- Bio-filters in aquarium.
- Construction, settings and maintenance of aquarium

UNIT-IV Ornamental fish Diseases and Management

- Ornamental Fish-diseases and their management
- Feed preparation for tropical/temperate ornamental fish
- Feeding, breeding and maintenance of ornamental fish.
- Health management in Ornamental Fish Farming.

ACTIVITIES

- 1) Identification & features of commonly used ornamental fishes: - Guppy, Molly, Platy, Sword Tail, Gold fish, Koi Carp, Danio- Zebra, and Flower Horn
- 2) Identification of locally available ornamental fishes in Kashmir water bodies.
- 3) Fabrication of all-glass aquarium demonstration and individual performance.
- 4) Setting-up and maintenance of aquarium
- 5) Introduction to Aquarium accessories and equipments
- 6) Conditioning and packing of ornamental fishes.
- 7) Preparation of ornamental fish feed.
- 8) Identification of ornamental fish diseases and prophylactic measures.
- 9) Identification of aquarium plants.

References (Books)

1. "Home Aquarium and Ornamental Fish Culture" by C S Tharadevi and N Arumugam.
2. A Complete Manual on Ornamental Fish Culture" by Srinivasan Muthurilappan.
3. "Ornamental Fish Culture and Aquarium Management" by A D Kholakia
4. "Marine Ornamental Species: Collection, Culture and Conservation" by James C Cato and Christopher L Brown.
5. "Porgy in Lake Tanganyika (Series of culture and appreciation of ornamental fish)" by wu meng.
6. "Live Food Cultures for the Ornamental Aquatic Industry" by Dr Chen Zaizhong and Dr John Clare.
7. "Aquaculture: An Introductory Text, 3rd Edition" by R R Stickney.

Semester IX

Population Ecology and Limnology

ZOO-CC-901

Credit: 4

Time: 60 Hours

Max. Marks: 100

Unit-I: Population ecology:

Population ecology, characteristics of population, population size and exponential growth, Limits of population growth, population dynamics, Life history strategies: r and K selection, clutch size and sex ratio. Concept of meta-population-demes and dispersion, Fertility rate and age structure, competition and coexistence, intra specific and interspecific interactions, Mutualism and commensalism. Ecological pyramids.

Unit-II: Community Ecology

Nature of communities and community analysis, community structure and attributes, levels of species diversity and its measurements, Edges and ecotones, interaction between environment and biota habitat and ecological niche. Concept of primary and secondary productivity, Concept of biome, productivity. Eutrophication of lakes, mechanism of eutrophication, cultural and natural eutrophication, biological indicator and water quality, law of limiting factors, law of minimum, laws of tolerance and trade of commerce.

Unit-III: Physical properties of inland water

Definition origin and history of limnology, Light sources, factors influencing light penetration, method of measuring light penetration and its relationship with aquatic organisms. Temperature effects on vital biological process and thermal stratification in oligotrophic and eutrophic lakes, Turbidity, causes and its impact on aquatic organisms, running waters in general; physical conditions; classification of lotic environments, biological conditions, Sources, methods of estimation and relationship with aquatic organism of Ca, Mg, P, Nitrate nitrite and ammonia. Distribution and variation of dissolved oxygen in lakes (Orthograde and Clinograde concepts) and rivers

Unit-IV: Biological properties of inland water

Plankton: planktonic organisms; classification of plankton; distribution of plankton: geographic, vertical, horizontal and seasonal distribution of phytoplankton and zooplankton; seasonal changes of body form in planktonic organisms; food of planktonic organisms; primary productivity: Nekton: composition, distribution, movements. Benthos: classification; periphyton; zonation; distribution; movements and migration; seasonal changes in benthos, profundal bottom fauna.

Suggested Readings:

1. Phillipson, J. 1966. Ecological Energetic, Edward Arnold Ltd. London.
2. Odum, E.P. 1970: Ecology, Amerind Publ. Co. New Delhi.
3. Odum, E.P. 1971. Fundamentals of Ecology, W.B. Saunders, USA.
4. Kormondy, E.T. 1971. Concept of Ecology. Prentice Hall of India, New Delhi. 5. Cole, A.A. 1974. text book of Limnology. The G.V. Mosby Company Saint Louis.

6. Arvind Kumar. 2005. Fundamentals of Limnology
7. Goldman, C.R. and Horne, A.J. 1983. Limnology. Mc Graw Hill International Book Company, New Delhi

Semester IX

Environmental and Conservation Biology

ZOO-CC-902

Credit: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Environmental education

History of environmental education, focus of environmental education, Stockholm declaration, Belgrade charter, Tbilisi declaration, concept of environmental education, environmental Act 1970, Aims, objectives and attributes of environmental education, the environment and its challenges, physical and cultural components of the environment

Unit-II: Environmental Hazards and Awareness

Environmental hazards and awareness, environmental pollution, causes effects and remedies, concept of Greenhouse Gases and greenhouse effect, ozone layer: Chlorofluorocarbons, Photochemical smog, Formation and destruction of ozone, Ozone Hole, Consequence of Ozone Depletion, Consequences of global CO₂ changes, Strategies for Conservation of Environmental Changes Induced by CO₂ Rise. Environmental awareness through non formal education, Acid rain: sources formation and its impact on biological systems.

Unit-III: Natural resource management

Environmental impact assessment: principal scope and purposes, Role of Individuals in Sustainable Environmental Management, Role of ecological restoration in conservation: displacement and settlement of local communities, major conservation movements in India, Role of NGOs in conservation movement. National legislation for protecting biological resources.

Unit-IV: Biodiversity conservation

Concepts and levels of biodiversity, species diversity, genetic diversity and ecosystem diversity, biodiversity hot spots and loss of biodiversity: cause and factors, Conservation on biological diversity (CBD) and issues under the CBD. Biological diversity act 2002 and provisions and rules 2004, overexploitation of resources, deforestation water table depletion and land degradation.

Suggested Books:

1. Caughley, G and A. Gunn 1996: conservation biology in theory and practice. Blackwell science, Cambridge, Massachusetts, USA
2. Aparnasawhney 2004 the new face of the environmental management in India., Ashgate publishing limited shellfield
3. S.C. Santra, "Environmental Science", 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
4. H. Kaur, "Environmental Studies", Pragati Prakashan, 2006.
5. Environmental education: Principles, methods and applications by trilochan. Bakshi, Zev 6. Naveh Plenum Press New York and London.

Semester IX
Vertebrate Endocrinology

ZOO-CC-903

Credits: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Endocrine Glands, Structure and Functions

Hypothalamo-hypophysial Complex, Hypothalamus, Structure and Function, Evolution of Pituitary Gland, Hormones of Adenohypophysis and Neurohypophysis. Structure of Thyroid Gland, its Hormones, their function and Disorders; Regulation of thyroid secretions; Parathyroid Gland and its Hormones; Role PTH and Calcitonin in maintaining Ca^{2+} level of Blood, Adrenal Gland, Structure and Location, Hormones of Adrenal Cortex and Medulla, their Functions and Disorders; Pineal and Thymus Gland, their Hormones.

Unit-II: Hormones, their action and Biosynthesis

Classification of Hormones, Characteristics of Hormones, Chemical Nature of Hormones, Mechanism of Hormone Action, the cAMP mechanism, Hormone Receptors, Role of Hormones in Animal Migration, Biosynthesis of Steroids Hormones and Thyroid Hormones, Biosynthesis of Corticosteroids, Biosynthesis of Adrenal Medullary Hormones, Synthesis of Insulin Hormone and mechanism of action, Types of Secretions, Role of Hormone in Biological Rhythms,

Unit-III: Hormonal Control of Metabolism and Reproduction

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 Control of Ovulation; Hormonal Regulation of Reproductive Cycles, Role of Hormones in Pregnancy, Parturition and Lactation, Placental Hormones (HCG, HCS, PMSG), Role of Hormones in Parental Care of Animals.

Unit-IV: Hormonal Regulation of Osmoregulation

Role of Neuro-hypophysial Hormone in the Osmoregulation of fishes, Urohypophysis, Corpuscles of Stannius and Juxta-Granular cells, Role of Ultimobranchial Glands in the Osmoregulation of Fishes, Hormonal Regulation of Osmoregulation in Amphibians, Role of Hormones in Osmoregulation of Terrestrial Vertebrates, Regulation of Water and Electrolytes by Mineralocorticoids, Renin-Angiotensin System, Role of Vasopressin in Mammals, Adrenocorticoids, Adrenalin, Angiotensin and Prolactin.

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.
6. Brook, Chales and Marshall (2000) Essential Endocrinology.

Semester IX
Laboratory Course

ZOO-CC-904
Credit: 04

Time: 60 Hours
Max. Marks: 100

1. Morphometry of some water bodies of Kashmir.
2. Determination of physical characteristics of lentic water bodies.
3. Determination of chemical characteristics of lentic water bodies.
4. Determination of physical characteristics of lotic water bodies.
5. Determination of chemical characteristics of lotic water bodies.
6. Collection and identification of fresh water phytoplankton. Enumeration and biomass estimation of freshwater phytoplankton.
7. Estimation of primary productivity in fresh water bodies. Collection and identification of fresh water zooplankton.
8. Enumeration and biomass estimation of fresh water zooplankton.
9. Collection and identification of benthos from lakes and ponds, streams and canals. Collection and identification of nekton/aquatic insects from freshwater bodies.
10. Collection and identification of aquatic plants from different fresh water bodies.
11. Field visit to lotic and lentic water bodies.
12. To study the biodiversity by quadrant method by determining frequency, density and abundance of different species
13. To determine the minimum number of quadrants to be laid down in the field under study
14. Understanding the concept of sampling: Random sampling, sample size, quadrat, transect and point method for the study of community structure
15. Biodiversity survey of local fauna
16. Principle of GIS, GPS and RS technology
17. Study of permanent slides of some endocrine glands
18. Demonstration of castration/ovariectomy in the lab bred Rats.
19. Extraction of pituitary gland from fish

Semester IX

Agricultural Pests/Medical & Veterinary Entomology

ZOO-DSE-901

Credits: 02

Time: 30 Hours

Max. Marks:50

Unit-I:General, Household and Forest pests

List of pests with life cycle, nature of damage and control of one major pest of forest (Poplar, Salix) & Pine trees; Stored grain (Pulses& cereals). House hold pests. Locusts- major species, Phase theory of locust, swarm formation and migration

Unit-II: Agricultural/Horticultural/General pests

List of pests with life cycle, nature of damage and control of one major pest of Paddy; Brinjal; Pulses(Rajma); Cabbage & Cauliflower. Horticultural crops: Apple & Pear/Peach;Walnut and Almond.

Unit-III: Insect Vectors of Human diseases

Mode of transmission and pathogenicity of Malaria, Filaria and Dengue. Life cycle of *Phlebotomus*, Tsetse fly (*Glossina* sp.) and Rat flea (*Xenopsilla*). Pathogenecity of Kalazar, Sleeping sickness and Plague.

Unit-IV.Insect Vectors of Animal diseases

Life cycle and control of *Stomoxys calcitrans*. Life cycle, pathogenecity and control of Myiasis causing flies (Primary Screw worm fly-*Cochliomyia hominivorax*,Ox warble fly-*Hypoderma lineatum*, Sheep Bot fly-*Oestrus ovis*).

Suggested Readings:

1. Atwal, A.S. Agricultural pests of India and South East Asia, Kalyani Publ.
2. Tembhare, D.B. Modern Entmology (Himalaya Publ.House)
3. Metcalf, C.L. & Flint, W.P. Destructive and Useful Insects (TataMcGraw Hill)
4. Gennard Dorothy, Forensic Entomology. John Wiley & sons.
5. Saxena, S.C. Biology of Insects (Oxform& IBH publ.)
6. Awasthi, V.B. Agricultural Insect Pests and their control (Scientific Publ.)

Semester IX
Laboratory Course

ZOO-DSE-902
Credits: 02

Time: 30 Hours
Max. Marks:50

1. Collection and Identification of Pests attacking Paddy in Kashmir.
2. Collection, preservation and Identification of the pests attacking Apples, Pear & Peach.
3. Survey, collection and preservation of stored grain pests.
4. Collection, preservation and mounting of Aedes, Culex and Anopheles.
5. Collection of Myiasis causing flies (*Calliphora* & *Sarcophaga*).
6. Collection and Identification of Forest pests of J & K.
7. Temporary mount preparation of Psychodids, Bird louse & Head Louse.
8. Collection and Identification of Borers attacking trees in J & K.

Semester IX

Parasite Immunology and Immunodiagnostics

Course Code: ZOO-DSE-903

Credits: 02

Time: 30 Hours

Max. Marks: 50

Unit-1: Overview of the Immune System

Medical Importance of the Immune System and its functioning. Current concepts in basic and clinical immunology with special emphasis on parasitic diseases in small ruminants. Types of immunity. Structure and classes of immunoglobulins. Role of lymphokines, T-cell receptors, macrophages, granulocytes, mast cells, platelets, antibodies in immunity.

Unit-II: Major Immunological Mechanisms

Mechanisms of humoral and cell mediated immune response. Suppression of host's immune response. Immunopathological consequences of parasitic infections. Defective and Damaging Immune responses - Hypersensitivity and Autoimmunity. Premunition and tolerance. Immuno-deficiencies: types and examples. Hypersensitivity reaction in defense against the parasite.

Unit-III: Immune Response against Specific Parasite groups

Immune responses against *Entamoeba histolytica*, *Leishmania*, *Plasmodium* spp, *Toxoplasma gondii*, Trypanosomiasis, *Haemonchus contortus*. Immunity against Helminths: Effector Immune Mechanisms against helminths. Immunoregulatory mechanisms associated with evasion of host immunity. Haematological and serological changes in relation to parasitic diseases in small ruminants.

Unit-IV: Immunodiagnostics

Diagnosis of infectious diseases. Agglutination-reaction based tests, Simple and double immunodiffusion (Ouchterlony's technique), Complement fixation test (CFT), Radioimmunoassay (RIA); ELISA: Direct, Agarose Gel Electrophoresis, SDS PAGE, Western Blot

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. Mosby/Elsevier.
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.
6. Weir DM. 1986. Handbook of Experimental Immunology. Vol. IV. Blackwell.

Semester IX

Laboratory Course

Course Code: ZOO-DSE-904

Credits: 02

Time: 30 Hours

Max. Marks: 50

1. Total Leucocyte Count (TLC) and Differential Leucocyte Count (DLC).
2. Demonstration of antigen-antibody interactions in serological tests such as agar gel precipitation.
3. Immuno-electrophoresis.
4. Direct and Indirect hemagglutination.
5. Complement fixation.
6. Immunoblotting.
7. Estimation of antibody titre through ELISA.
8. SDS - PAGE
9. Western blotting for the detection of antibodies.
10. Detection of Parasite Antigen: Western Blot.

Semester IX

Fish Culture, Adaptations and Health

ZOO-DSE-905

Credits: 02

Time: 30 Hours

Max Marks: 50

Unit-I: Culture Techniques :

Integrated fish culture with duck farming and Poultry farming, Composite fish culture. General account of Crab culture and Oyster culture, Pen and cage culture, Raft culture, Extensive, Semi-intensive and Intensive culture. Aquatic weeds, their control and importance

Unit-II: Special Adaptations:

Hill stream fishes' Condition in hill streams, modification in the fish fauna, external shape and form of the body, Adhesive apparatus, structure and mechanism of adhesion, Adaptations in Deep Sea Fishes, Methods of maintaining buoyancy, Arctic and Antarctic fishes (avoidance of freezing), Cave dwelling fishes.

Unit-III: Fish Health and Management

Significance of Fish disease in aquaculture; Factors affecting fish health: host susceptibility, pathogen & environment; Major fish diseases: Nutritional diseases (Avitaminosis, Mineral deficiency, Starvation) and Diseases caused by parasites and pathogen: (Bacteria, Viruses, Fungi, Algae, Protozoan, Helminth and Crustaceans) Health management strategies: monitoring/inspection of fish diseases, Sanitation and disinfection, Vaccines, Immuno-stimulants, Antibiotics, Genetic resistance to disease in fish; Defensive devices in fish against diseases.

Unit-IV: Fish Toxicology

Toxicology: definition and types of toxicants in aquatic systems; Impact of toxicants on major target organs and organ system: liver, gills, kidney, nervous system and reproductive system; General account on Pesticide toxicity and Heavy metal toxicity; Bioaccumulation; Radioactive waste and its impact on fishes; Oil spills and its impact on fishes; Toxicity assessment of fish and determination of Lc. 50, Adaptive capabilities of fishes to long term exposure of pollutants.

Suggested Readings:

1. Cole, A.A. 1974. text book of Limnology. The G.V. Mosby Company Saint Louis
2. Jhingran, V.G. 1982. Fish and Fisheries of India. Hindustan Publishing corporation, India.
3. Arvind Kumar. 2005. Fundamentals of Limnology
4. Lagler, Bardock, Miller & Possino, John Wiley & Sons, N.Y., London: 2012. Ichthyology, 2nd Ed.
5. Arvind Kumar and Pushaplata Dubey. Daya Publ. House, Delhi. 2006. Fish Management and Aquatic Environment
6. Rajiv Tyagi and Arvind, N, Shukla 2002. Adaptation in Fishes

Semester IX
Laboratory Course

ZOO-DSE-906
Credits: 02

Time: 30 Hours
Max Marks: 50

1. Qualitative and quantitative analysis of phytoplankton in a sample from a water body.
 2. Qualitative and quantitative analysis of zooplankton in a sample from a water body.
 3. Study of water temperature and pH of a water body and their significance.
 4. Identification of common freshwater benthic organisms.
 5. Study of adhesive apparatus and other hill stream characters from fish specimen.
 6. Measure dissolved oxygen from two water sample collected from different location and study pollution status (lake and sewage water).
- Any other practical found feasible by the teacher

Semester IX
Animal Resources
ZOO-OGE-901
Credits: 04

Time: 60 Hours
Maximum Marks: 100

Unit I. Poultry Farming

Current Status and opportunities in Kashmir, Introduction of Poultry birds, Indigenous and Exotic Breeds their history & importance, Classification of fowls based on their use ; meat type, (broilers), egg type (White Leghorn and commercial layers), Dual purpose varieties, game and ornamental purpose varieties, poultry feed, diseases of poultry birds and their management, General management practices in poultry farming.

Unit II. Beneficial Insects

Silk Worm, life cycle and culture practices, Honey bees, different species involved in Apiculture, flora of honey bees, role of apiculture in employment generation and rural development, insects as pollinators and biological control agents.

Unit III. Dairy Farming

Introduction of Dairy Animals, Indigenous and Exotic Breeds of Cows, General Management Practices of Dairy Farming including Housing, Feeding, Rationing, Breeding and Vaccination, Dairy Products and their marketing, Varietal Improvement Techniques of Dairy Animals, Common Diseases of Lactating Cows and their Management.

Unit. IV. Pet Animals and Fish Farming

General Introduction of Pet Animals: Dog, Cat , Cage Birds , (Parrots, Pigeons), Rabbits; Pet. Animals and Employment Generation ; Feeding, Housing, Cleaning of Pet Animals; Commercial Breeding of Pet Animals; Diseases of Pet Animals including Zoonoses. Overview and Practices of Fish Farming with its Scope in Employment Generation.

Suggested Readings

1. Agrawal, V. K. (1994). *Production and Marketing of Poultry Products in India*. New Delhi: Mittal Publications.
2. *All India Poultry Business Directory Year Book 2003-04*. (2004). Gaziabad: Sadhana Publishers & Distributors.
3. Banerjee, G. C. (1993). *Poultry*. New Delhi: Oxford & IBH Publishing Company Pvt. Limited.
4. Bhandarkar, P. L., & Wilkinson, T. S. (1998). *Methodology and Techniques of Social Research*. Mumbai: Himalaya Publishing House.
5. Bhar, B. K. (2001). *Cost Accounting*. Calcutta: Academic Publishers. Bhuktar, V. M., & Borole, S. M. (1997). *Broiler Production*. Pune: Rane Nilima Pravin.
6. *Handbook Of Care And Management Of Laboratory And Pet Animals Hardcover – Import*, 2009 by Y B Rajeshwari.
7. *Companion Animals: Their Biology, Care, Health, and Management (2nd Edition)* 2nd Edition by Karen L. Campbell (Author), John R. Campbell PhD. D.Sc. (Hon.)
8. *Guide for the Care and Use of Laboratory Animals*. 8th edition, National Research Council (US) Committee for the Update of the Guide for the Care and Use of Laboratory Animals. Washington (DC): National Academies Press (US); 2011.
9. Watson, J A S and Mills, w j 2005. *Farm animals and their management*.
10. Jagdish Prasad, *Animal Husbandry & Dairy Science*.

Semester X

Comparative Animal Physiology

ZOO-CC-10-01

Credit: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Physiology of Nutrition excretion

Nutrition patterns-origin of nutrition types, carbon and nitrogen assimilation and the possible evolution of nutritional patterns. Identification of specific factors in nutrition; special dietary requirements of some animals; digestive enzymes and their role; gastro-intestinal hormones in vertebrates; comparative biochemistry of nitrogen excretion-by products of nitrogen catabolism; ammonia toxicity and detoxification pathways.

Unit-II: Physiology of Respiration

Respiration and metabolic adaptations- availability of oxygen in the environment and metabolism as related to the environmental oxygen tension; diving adaptations in Vertebrates; Altitudinal adaptations to low oxygen pressure, oxygen toxicity in anaerobic organisms. Gas secretion and absorption in Coelenterate floats and swim bladder in fish

Unit-III: Circulation of body fluids

Open and closed vascular system and fluid compartments; peripheral circulation in invertebrates, pressure and flow in vertebrates' circulatory systems; physiological and pharmacological types of hearts with special reference to Annelids, Molluscs, Arthropods, tunicates and vertebrates. Haemoglobin and its physiological significance in vertebrates and Invertebrates, factors modifying combination of haemoglobin with oxygen, effects of reduced oxygen on synthesis of haemoglobin.

Unit-IV: Physiology of Muscle

The biophysics and biochemistry of contraction with special reference to the physiology of skeletal muscle fibres; ultra-structure and structural proteins of muscle cells; actomyosin complex and the source of energy for contraction; sliding filament theory of muscle contraction. Excitation of muscle contraction and mechanism of coupling between electrical and chemical events; mechanism of relaxation, work and heat relation in muscle contraction.

Suggested Readings

1. Guyton, A.G. 1986. Text book of Medical Physiology, 7th 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.

Semester X

Environmental Physiology

ZOO-CC-10-02

Credit: 04

Time: 60 Hours

Max. Marks:100

Unit-I: Basic Concept of Stress

Physical and Biological concepts of stress and strain; elastic and plastic strain; stress tolerance (conformity) and avoidance (regulation); types of stress injury; homeostasis; adaptations (genetic and physiological). Acclimation and Acclimatization capacity and resistance acclimation.

Unit-II: Thermal Stress

Structural and rate effects; thermal limits of survival; poikilothermy and homeothermy; ectothermy and endothermy; endothermy in invertebrates; nature of chilling and freezing injuries; mechanism of cold resistance in insects; mechanism of heat resistance molecular mechanisms of thermal acclimation in poikilotherm- homeokinetic and homeoviscous adaptations.

Unit-III: Water, Osmotic and Ionic Stress

Preservation of intracellular solvent capacity and associated metabolic adaptations. Strategies and degrees of ionic regulation; regulation of intra-cellular osmolarity; role of glutamate dehydrogenase; coupling of water transport to active transport of solutes. Sodium pump and sodium and potassium ions ATPase in relation to salinity adaptation; ion transport in the avian salt gland.

Unit-IV: Pressure Stress/Oxygen Deficient Stress

Structural and rate effects; enzymatic adaptations to hyperbaric stress in deep sea fishes; biochemical mechanisms of adaptation in mammals to high altitude (hypobaria and hypoxia); oxygen debt in vertebrate muscle and its anoxia adaptation; anoxia adaptations in anaerobic vertebrates; adaptations in vertebrates for prolonged diving.

Suggested Readings:

1. Slonim, N. B. 1974. Environmental Physiology. C.V. Mosby publ. St. Louis
2. Phillips, J.G. 1975. Environmental Physiology. Blackwell Sci. Publ.
3. Newell, R.C. ed. 1976. Adaptation to environment. Essays on the Physiology of marine animals. Butterworths.
4. Smellie, R.M.S. ed. 1976. Biochemical adaptation to environmental change. Acad. Press

Semester X
Cell and Molecular Biology

ZOO-CC-10-03

Credits: 04

Time: 60 Hours

Max. Marks: 100

Unit-I: Cell Membrane; Structure, Function and its Modifications

Structure and models of cell membrane, 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: Role of Cell Organelles and Extracellular Matrix

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, Nucleosome Organisation, Structure and Function of Centrioles and Basal Bodies, Microtubules Organising Centres (MTOCs), The Extracellular Matrix- Collagen, Elastin, Fibrin, Fibronectin, Laminin and Proteoglycans. Mechanism of Programmed Cell Death.

Unit-III: DNA Replication, Repair and Recombination

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*., DNA Recombination; Homologous Recombination (Holliday Model and Double Strand break Model), Site Specific Recombination.

Unit-IV: Transcription, Translation and Gene Expression

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, Role of Repressors and Activators in Splicing Alternative Sites, Role of Splicing in Sexual Differentiation of *Drosophila*, Transport of mRNA across the Nuclear Envelop. Translation; Mechanism of Initiation, Elongation and Termination in Prokaryotes, and Eukaryotes, Regulation of Translation. Gene Regulation in Prokaryotes, Lac Operon and Tryptophan Operon in Prokaryotes. Gene Organization in Eukaryotes, Highly Repetitive (Satellite DNA), Middle Repetitive (rDNA, 5sDNA, Histone Genes, Telomere and Centromere DNA)

Suggested Readings:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons, Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th 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.

Semester X
Laboratory Course

ZOO-CC-10-04
Credit: 04

Time: 60 Hours
Max. Marks: 100

1. Determination of activities of some digestive enzymes
2. To examine the blood group of some human beings.
3. Determination of the total count of W.B.C and R.B.C of a human beings
4. Estimation of Haemoglobin in mammals.
5. Determination of Rh factor in humans
6. To determine ESR of human blood
7. Preparation of haematin crystals.
8. Observation on activities of insect and fish at different temperature in the lab.
- 9 Observations of the effect of decreasing PO₂ of water on the respiratory rate of a fish and determination of lactic acid content in its muscles.
10. Preparation of temporary stained squash of Grasshopper testes to study various stages of Meiosis.
11. Quantitative estimation of RNA using Orcinol reaction.
12. Study and Interpretation of electron micrographs/photographs showing
 - (a). DNA Replication
 - (b). Transcription.
13. Extraction of DNA and RNA.

Semester X
Insect Behaviour and control

ZOO-DSE-10-01
Credits: 02

Time: 30 Hours
Max. Marks: 50

Unit -I: Insect Behaviour

Social organizations in insects (Presocial, Subsocial and Eusocial Insects); Chemical communication in insects; Parental care in insects; Defensive behaviour in insects: Circadian Rhythm in insects; Feeding and Oviposition behaviour in insects.

Unit-II: Chemical Insecticides- I

Insecticides of plant origin (Pyrethrum, Neem, rotenone etc), their toxicity and mode of action. Organochlorine insecticides- classification, mode of action and their hazards. Organophosphate and Carbamate insecticides- classification and mode of action.

Unit-III: Chemical Insecticides- II

Chemosterilants- methods of application, advantages and effectiveness. Fumigants-General account and their limitations. Repellent- classification and advantages, Attractant-general account. Pyrethroids-General account.

Unit-IV: Cultural/ Biological & Microbial control

Cultural control of insect pests- principle, methods and techniques with suitable examples. Biological Control- Predatory and Parasitoid insects with examples. Microbial control (virus, bacteria, fungus etc.)- their mode of action, advantages and disadvantages.

Suggested Readings:

1. Gilbert, L.I. & Gill, S. Insect Control (Academic Press)
2. Metcalf, C.L. & Flint, W.P. Destructive and Useful Insects (Tata Mcgraw Hill Publ)
3. Perry, A.S., Yamamoto, I. Ishaaya, I. & Perry, R.Y. Insecticides in Agriculture and Environment. Retrospect and Prospect.
4. Dyck, V.A., Hendrick, J. & Robinson, A.S. Sterile Insect Technique: Principles and practice in Area-wide Integrated Pest.
5. Pedigo, L.P. & Marlin, E.R. Entomology and Pest Management.
6. Flint, M.L., Vanden, B.R. Introduction to Integrated Pest Management.
7. Horowitz, A.R., Ishaaya, I., Insect Pest management- Field and protected crops.
8. Atkins, M.F. Insect Behaviour.
9. Mathews, R.W. & Mathews, J.R. Insect Behaviour (Springer

Semester X
Laboratory Course

ZOO-DSE-10-02

Credits: 02

Time: 30 Hours

Max. Marks:50

1. Methods of preparation of Insecticidal formulations (Dusting, Solutions, Emulsions).
2. Techniques to handle the appliances used in spraying insecticides.
3. Observation of efficacy of a Repellent in mosquitoes.
4. Observation of efficacy of an Attractant in Cockroaches/ Flies.
5. Observation of the efficacy of a Pyrethroid in Mosquitoes, Flies.
6. Study of Katelepsy in insects.
7. Study of Predatory behaviour in *Coccinella*.

Semester X

Emerging Zoonotic and Parasite Management

Course Code: ZOO-DSE-10-03

Credits: 02

Time: 30 Hours

Max. Marks: 50

Unit-I: Emerging & Re-emerging Diseases

Introduction on re-emerging diseases, factors responsible for the emergence and re-emergence of infectious diseases. Causes, mode of transmission and prevention of following emerging diseases: Flavobacterial diseases, Infectious haematopoietic necrosis (IHNV), Rift Valley fever virus in small ruminants.

Unit-II: Zoonotic Diseases

Classification of Zoonosis, mode of Transmission, [surveillance and monitoring of zoonosis](#). Epidemiology and distribution of following zoonotic diseases: Zika Virus, Ebola Virus, Influenza A virus subtype H1N1.

Unit-III: Control and Management of Parasitic Diseases

Classification of antihelmintics. Conventional and novel methods for control of helminths – antihelmintics, their mode of action, characteristic of an ideal antihelmintic, anthelmintic resistance, spectrum of activity, delivery devices, integrated control method and immunological control. Formulation of deworming schedule.

Unit-IV: Clinical Parasitology

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

Suggested Readings

1. Faust EC, Russell PF & Jung RC. 1971. Craig and Faust's Clinical Parasitology. Lea & Febiger.
2. Sloss MW, Kemp RL & Zajac AM. 1994. Veterinary Clinical Parasitology. Indian Ed. International Book Distr. Co.
3. Soulsby E.J.L. 1965. Textbook of Veterinary Clinical Parasitology. Blackwell.
4. Kaufmann J. 1996. Parasitic Infections of Domestic Animals. Birkhauser Verlag.
5. Mehlhorn H (Ed). 2001. Encyclopedic Reference of Parasitology: Diseases, Treatment, Therapy. Springer Verlag.
6. Chaudhri SS & Gupta SK. 2003. Manual of General Veterinary Parasitology. International Book Distr. Co.
7. Durr P & Gatrell A. 2004. GIS and Spatial Analysis in Veterinary Science. CABI.
8. Ministry of Agriculture, Fisheries and Food (MAFF). 1986. Manual of Veterinary Parasitological Laboratory Techniques. 3rd Ed. Tech. Bull. 18, HMSO.
9. Rathore VS & Sengar YS. 2005. Diagnostic Parasitology. Pointer Pub

Semester X
Laboratory Course

Course Code: ZOO-DSE-10-04

Time: 30 Hours

Credits: 02

Max. Marks: 50

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. Qualitative urine examination for parasitic infections.
5. Study of helminth parasites of vertebrates from prepared Slides, Charts and Models.
6. Methods of collection of helminth parasites from vertebrates.
7. Fixatives, Preservatives and methods of fixation & preservation of helminth parasites from vertebrates.
8. Permanent stained whole mounts preparation of trematodes, cestodes and Acanthocephala from some vertebrates.
9. Temporary whole mount preparation of nematodes from some vertebrates.
10. Permanent whole mount preparations of nematodes from some vertebrates.
11. Light and electron microscopic study of some parasites.
12. Collection of Ectoparasites from some ruminants.
13. Collection, processing and permanent preparations of Ectoparasites from birds.

Semester X

Fish Resource, Collection and Preservation

ZOO-DSE-10-05

Credits: 02

Time: 30 Hours

Max Marks: 50

Unit-I: Fishery Economics

Importance of Fishery Science, Fish catch statistics: A general survey of inland and marine fish catches of India and the world (Available Fishing Potential, Estimation of Inland fish, Estimation of marine fish landings); 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.

Unit-II: Inland Fish Resource

Riverine Fisheries: River systems in India and their fisheries (Ganga, Brahmaputra and Indus); Reservoir Fisheries: Development, Exploitation and management of Reservoirs with special reference to India – Dams and their effect on fish migration; Lacustrine fisheries, Cold water fisheries, Estuarine fisheries and characteristics of estuary.

Unit-III: Marine Fisheries

Marine fish catch in India and fisheries of commercial importance Fin Fish: Oil Sardines; Mackerels; Tuna; Hilsa fish; Pomfret Fish; fisheries of importance shell fish; Crustaceans, Molluscs, Edible oysters and Sea weeds; Migration of fishes: anadromous and catadromous migration; Factors influencing fish production along West and East coast.

Unit-IV: Fishing Methods and Preservation

Traditional fishing methods (crafts and gears) used in India, recent advance in fishing methods: light fishing and electric fishing; Principles and Types of fish preservation: traditional methods of preservation, Sun drying, Salting, Curing and advanced methods of preservation, Smoking, Canning, Chilling; Post-mortem changes in fish (Rigor mortis), Spoilage of fish and reasons for spoilage.

Suggested Readings:

1. P.N. Pandey. 2005. Economics of Fisheries
2. Sarkar, S.K. 2002. Freshwater Fish Culture. Daya Publ. House, New Delhi.
3. Jagtap, H.S, S.N. Mukherjee and V.K. Garad. 2009. A Textbook of Pisciculture and Aquarium. DayaPubl.House, New Delhi.
4. Selvamani, B.R and R.K. Mahadevan. 2008. Fish Harvesting and Processing. Campus Books International.

Semester X
Laboratory Course

ZOO-DSE-10-06
Credits: 02

Time: 30 Hours
Max Marks: 50

1. Survey and collection of lacustrine fishes of the Valley.
 2. An account on the visit to fish farm to study carp and trout culture.
 3. Study of open, semi-closed and closed water culture from field visit.
 4. To study post-Mortem changes in fish.
 5. Identification and classification of local fishes of J&K through museum specimen.
 6. Study of various fishing methods either from pictures or original materials like nets etc.
- Any other practical found feasible by the teacher

Semester-X
Organic Farming
ZOO-OGE-10-01

Time: 60 hours
Marks: 100
Credits: 04

Unit I: Concept of organic farming

7 lectures

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

8 lectures

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

7 lectures

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

8 lectures

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