

SYLLABUS FOR B.Sc. ZOOLOGY (Honours) DEGREE PROGRAM UNDER CBCS w.e.f. 2017-18 of SEM I & II

Course Structure of CBCS B.Sc. Zoology (Honours) degree program

SEMESTER I (F.Y. B.Sc.)				
PAPER CODE	TITLE		CREDITS	TOTAL CREDITS
ZOCH 1	Diversity of Non-chordates	Theory	04	06
		Practical	02	
ZOCH 2	Cell Biology	Theory	04	06
		Practical	02	
ZOCH 3	Parasitology	Theory	04	06
		Practical	02	
GEH 1A [#]	Pest Management	Theory	03	04
		Practical	01	
GEH 1B [#]	Insect Vectors and Diseases	Theory	03	04
		Practical	01	
SEMESTER II (F.Y. B.Sc.)				
ZOCH 4	Diversity of Chordates	Theory	04	06
		Practical	02	
ZOCH 5	Principles of Genetics	Theory	04	06
		Practical	02	
ZOCH 6	Principles of Ecology	Theory	04	06
		Practical	02	
GEH 2A [#]	Wildlife and Eco-tourism	Theory	03	04
		Practical	01	
GEH 2B [#]	Poultry Science	Theory	03	04
		Practical	01	
SEMESTER III (S.Y. B.Sc.)				
PAPER CODE	TITLE		CREDITS	TOTAL CREDITS
ZOCH 7	Comparative anatomy of Vertebrates	Theory	04	06
		Practical	02	
ZOCH 8	Animal Physiology: Life sustaining system	Theory	04	06
		Practical	02	
ZOCH 9	Fundamentals of Biochemistry	Theory	04	06
		Practical	02	
SECH 1	Aquarium Fish keeping	Theory	03	04
		Practical	01	
GEH 3A [#]	Zoo-geography and Conservation Biology	Theory	03	04
		Practical	01	
GEH 3B [#]	Wetland Ecology	Theory	03	04

		Practical	01	
SEMESTER IV (S.Y. B.Sc.)				
ZOCH 10	Developmental Biology	Theory	04	06
		Practical	02	
ZOCH 11	Endocrinology	Theory	04	06
		Practical	02	
ZOCH 12	Biochemistry of Metabolic Processes	Theory	04	06
		Practical	02	
SECH 2	Bio-techniques	Theory	03	04
		Practical	01	
GEH 4A [#]	Food, nutrition and Health	Theory	03	04
		Practical	01	
GEH 4B [#]	Environment Impact Assessment	Theory	03	04
		Practical	01	
SEMESTER V (T.Y. B.Sc.)				
PAPER CODE	TITLE		CREDITS	TOTAL CREDITS
ZOCH 13	Molecular Biology	Theory	04	06
		Practical	02	
ZOEH 1 [§]	Environmental Biology and Toxicology	Theory	04	06
		Practical	02	
ZOEH 2 [§]	General Entomology	Theory	04	06
		Practical	02	
ZOEH 3 [§]	Animal Cell Culture	Theory	04	06
		Practical	02	
SECH 3	Haematology	Theory	03	04
		Practical	01	
SEMESTER VI (T.Y. B.Sc.)				
ZOCH 14	Fundamental of Animal Biotechnology	Theory	04	06
		Practical	02	
ZOEH 4 ^{&}	Aquaculture	Theory	04	06
		Practical	02	
ZOEH 5 ^{&}	Economic Zoology	Theory	04	06
		Practical	02	
ZOEH 6 ^{&}	Research Methodology and Biostatistics	Theory	04	06
		Practical	02	
SECH 4	Fish and fish products	Theory	03	04
		Practical	01	
ZOPH [*]	Project			04

NOTE: ZOCH = Discipline Specific Core; GEH = Generic Elective; ZOEH = Discipline Specific Elective; SECH = Skill Enhancement Course; # Select any one, either 'A' or 'B', in each Semester; §Select any two; & Select any two; * In lieu of any one ZOEH.

SEMESTER I

ZOCH 1: DIVERSITY OF NON-CHORDATES

Theory

Credits: 04

Duration: 60 clock hours

Learning Objective: To know the general characters and classification of Non-chordates and understand the increasing complexity of body forms.

Learning Outcome: On completion of the course the student should be able to know the general organization of Non-chordates as a group and know the taxonomy and characteristic features of the various Non-chordate phyla.

Unit 1. Introduction to Taxonomy	02
General Principles of Systematics and Animal classification, Origin and development of Systematics, Binomial nomenclature and rules	
Unit 2. Protozoa	06
Type : <i>Paramecium</i> General Topics : organelles in Protozoa, ii) Modes of Nutrition in Protozoa	
Unit 3. Porifera	05
General Topics: i) Cell types in Porifera, ii) Skeleton in Porifera, iii) Canal System in Porifera iv) Reproduction in Porifera	
Unit 4. Cnidaria	05
Type: <i>Obelia</i> General Topics: Polymorphism in Cnidaria	
Unit 5. Ctenophora	01
Habit, Habitat and External Morphology of <i>Pleurobrachia</i>	
Unit 6. Platyhelminthes	05
Type : <i>Dugesia</i>	
Unit 7. Aschelminthes	01
Bionomic importance of Aschelminthes	
Unit 8. Annelida	05
Type : <i>Nereis</i> General General Topics : Metamerism in Annelida	

Unit 9. Onychophora	02
Habit, Habitat and External Morphology of <i>Peripatus</i> , Phylogenetic significance of Onychophora	
Unit 10. Arthropoda	12
Type : <i>Periplaneta</i> General Topics : i) Respiration in Arthropoda ii) Metamorphism in Insects	
Unit 11. Mollusca	10
Type : <i>Pila</i> General Topics: i) Foot in Mollusca ii) Shell in Mollusca	
Unit 12. Echinodermata	06
Type: <i>Asterias</i> General topic: Symmetry in Echinoderms and Echinoderm larvae.	

Note:

1. Review of the general characters and classification of the following (up to class level). For Classification, refer Barnes R.D. (2000) *Invertebrate Zoology*. Saunders College Publishing
- Indigenous and local examples with common and scientific names are to be mentioned. Exotic specimen may be cited wherever needed.
- At least one example from each class of invertebrates has to be included. Only those examples need to be mentioned which explain the general characters of the phylum/class.
- The gross anatomy and life history of the types mentioned should be included.

PRACTICALS:

CREDITS: 02

- Study of animals belonging to Protozoa, Porifera, Cnidaria, Ctenophora, Platyhelminthes, Aschelminthes and Annelida with special reference to systematic position up to class level, habit, habitat, characteristic features and economic importance (one example of each class and Local examples are to be given more emphasis) with the help of Museum specimens, models, charts, Microslides, Photographs and Digital sources.
- Study of animals belonging to - Onychophora, Arthropoda, Mollusca, Echinodermata with special reference to systematic position up to class level, habit, habitat, characteristic features and economic importance . (one example of each class and Local examples are to be given more emphasis) with the help of Museum specimens, Models, Charts, Microslides, Photographs and Digital sources
- Study of sand Foraminiferans.
- Identification of Protozoans and Coelenterates in pond water sample
- Digestive system of Earthworm (Museum specimen/digital sources)
- Nervous system of Earthworm (Museum specimen/digital sources)

- Digestive system of Cockroach (Museum specimen/digital sources)
- Mouth parts of Honey bee (Permanent slides/ Microphotographs/digital sources)
- Mouth parts of House fly, Mouth parts of Cockroach (Permanent slides/ Microphotographs/digital sources)
- Radula of *Pila*, Digestive system of *Pila* (Museum specimen/digital sources)
- Nervous system of *Pila* (Museum specimen/digital sources)
- Larvae of *Asteroidea* (Permanent slides/ Microphotographs/digital sources)
- Nervous system of Cockroach (Museum specimen/digital sources)
- Appendages of Prawn (mounting should be carried out)
- Male and female reproductive system of cockroach

Suggested Readings:

1. *Jordan E.L., Verma P. S. (1987) Invertebrate Zoology. S. Chand and Company Pvt. Ltd. New Delhi.*
2. *Kotpal R.L. (2000) Invertebrates. Rastogi Publi. Meerut*
3. *Ekambaranatha Ayyar, M. Ananthkrishnan, T N. Outlines of Zoology, S. Vishwanathan, Madras*
4. *Prasad S.N. (Reprint 1992) Life of Invertebrates. VikasPublishing House Pvt. Ltd.*
5. *Dhami P.S., Dhami J.K. Invertebrate Zoology. S. Chand and Company Pvt. Ltd. New Delhi.*
6. *Parker A.J., Haswell W. A. A. (2002) Textbook of Zoology Vol. I . Mc millan*
7. *Ganguly B. B., Sinha A.K. and Adhikari S. (2000) Introduction to biology of Animals. New Central Book Agency, Calcutta*
8. *Barnes R.D. (2000) Invertebrate Zoology. Saunders College Publishing*

SEMESTER I
ZOCH 2 : CELL BIOLOGY

Theory
Credits: 04

Duration: 60 Clock hours

Learning Objective: To know the organization and function of biological cell(s).

Learning Outcome: On completion of this course the student should understand the architectural details and functions of cell and cell organelles.

Unit 1: Overview of Cells	3
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions	
Unit 2: Plasma Membrane	7
Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions	
Unit 3: Endomembrane System	10
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	
Unit 4: Mitochondria and Peroxisomes	8
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes	
Unit 5: Cytoskeleton	8
Structure and functions; Microtubules, Microfilaments and Intermediate filaments	
Unit 6: Nucleus	12
Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)	
Unit 7: Cell Division	8
Mitosis, Meiosis, Cell cycle and its regulation	

Unit 8: Cancer Cells

4

Apoptosis, Types of Cancer, Salient features of Cancerous cells

PRACTICALS

Credits: 02

- Microscopic study of different types of cells: Epithelial cells, Connective cells, Muscle cells
- Study of eukaryotic and prokaryotic cells
- Preparation of temporary stained squash of onion root tip to study various stages of mitosis. Determination of Mitotic index
- Study of various stages of meiosis.
- Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
- Study to demonstrate:
 - DNA by Feulgen reaction
 - DNA and RNA by MGP
 - Localisation of Mitochondria using Janus green stain
 - Mucopolysaccharides by PAS reaction
 - Proteins by Mercurobromophenol blue/Fast Green

SUGGESTED READINGS:

- *Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.*
- *De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.*
- *Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.*
- *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.*
- *Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.*

SEMESTER I

ZOCH 3: PARASITOLOGY

Theory

Credits: 04

Duration: 60 Clock Hours

Learning Objective: To study the biology of parasites.

Learning Outcome: On completion of this course the student should be well versed with the lifecycles and pathogenicity of various parasites.

Unit I: Introduction to Parasitology

3

Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (vectors and vehicles of transmission) Host parasite relationship

Unit II: Parasitic Protists

15

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax*

Unit III: Parasitic Platyhelminthes

15

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana*

Unit IV: Parasitic Nematodes

15

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis*. *Pratylenus* (lesion nematode)

Unit IV: Parasitic Arthropoda

10

Biology, importance and control of ticks, mites, fleas and bedbugs, head and body louse (local examples to be considered)

Unit V: Parasitic Vertebrates

2

A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat

PRACTICALS

Credits:02

- Study of life stages of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs

- Study of adult and life stages of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
- Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs.
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
- Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product]

SUGGESTED READINGS

- Arora, D. R and Arora, B. (2001) *Medical Parasitology. II Edition. CBS Publications and Distributors*
- E.R. Noble and G.A. Noble (1982) *Parasitology: The biology of animal parasites. V Edition, Lea & Febiger*
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) *Biology of Disease. Taylor and Francis Group*
- Parija, S. C. *Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi*
- Rattan Lal Ichhpujani and Rajesh Bhatia. *Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi*
- Meyer, Olsen & Schmidt's *Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers*
- K. D. Chatterjee (2009). *Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.*

SEMESTER I

GEH 1A: PEST MANAGEMENT

Theory

Credits: 03

Duration: 45 clock hours

Learning Objective: To learn about pests and strategies of pest-management.

Learning Outcome: On completion of the course the student should be able to know about the common household and agricultural pests and the various approaches in their management.

Unit 1: Introduction to Pest Management	05
<ul style="list-style-type: none">• Definition, brief history of pest control• Overview and Principles of Ecologically Based Pest Management• Promises and perils of pesticides	
Unit 2: Common household and Agricultural pests	10
<ul style="list-style-type: none">• Weeds – undesirable plants.• Invertebrates – insects, mites, ticks, spiders, snails, and slugs.• Disease agents or pathogens –bacteria, viruses, fungi, nematodes mycoplasmas, and other microorganisms.• Vertebrates – birds, reptiles, amphibians, fish, and rodents and other mammals.	
Unit 3: Pest Monitoring and Forecasting	10
<ul style="list-style-type: none">• Concept of Pest monitoring, pest surveillance, pest forecasting• Survey - Roving and fixed plot.• Sampling – absolute and relative techniques, methods of sampling :• Insitu counts, knock down, netting, narcotized collection, trapping (light trap, pheromone trap, sticky trap, bait trap, emergence trap).	
Unit 4: Biological control:	08
<ul style="list-style-type: none">• Ecological considerations, biological control of insects, control using predators, parasitoids and microbes	
Unit 5: Regulatory cultural control and Chemical control:	06

- Quarantine, Eradication, sanitation, tillage, crop rotation, cropping systems
- Ecological considerations, pesticide classification, pesticide resistance, chemical mode of action.

Unit 6: Biotechnological and molecular approaches in pest management:

06

- Genetic manipulation of pest population: sterile insect release, delayed sterility, genetic displacement.

PRACTICAL

Credits 01

- Study of different types insect traps: Light trap, Pitfall trap.
- Study of pests by Fixed plot method of survey
- Preparation of funnel trap and cockroach bait.
- Capturing flies – banana bait fly trap.
- Sampling of pests by light trap/pitfall trap, sticky trap .
- Identification of Agricultural pests. Identification of pests on campus(pest of any plant)
- Visit to an institute to study Pest Management.

Reference books:

1. Dharam Abrol (2014). *Integrated pest management – Principle and practices*. Elsevier
2. Dharam Abrol (2014). *Integrated pest management – Current Concepts and Ecological Perspective*, Elsevier
3. Harsimran Kaur Gill and Gaurav Goyal, (2016) "*Integrated Pest Management (IPM): Environmentally Sound Pest Management*", Academic Press.

SEMESTER I

GEH 1B : INSECT VECTORS AND DISEASES

Theory

Credits: 03

Duration: 45 clock hours

Learning Objective: To learn the different insect vectors and the associated diseases.

Learning Outcome: On completion of the course the student should be able to know the features of the various insect vectors, associated diseases and their control measures.

Unit 1: Introduction to Insects	06
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts (based on feeding habits).	
Unit 2: Concept of Vector	05
Brief introduction of Carrier and Vectors (mechanical and biological vector) Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity	
Unit 3: Insects as Vectors	08
Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera	
Unit 4: Dipteran as Disease Vectors	10
Dipterans as important insect vectors – Mosquitoes, Houseflies; Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Filariasis; Control of mosquitoes Study of house fly as important mechanical vector, Myiasis, Control of house fly	
Unit 5: Siphonaptera as Disease Vectors	06
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas	
Unit 6: Siphunculata as Disease Vectors	04
Human louse (Head, Body and Pubic louse) as important insect vectors; Study of	

louse-borne diseases –Typhus fever, Relapsing fever, Trench fever, Vagabond’s disease, Phthiriasis; Control of human louse

Unit 7: Hemiptera as Disease Vectors

06

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures.

PRACTICAL

Credits 1

- Study of different kinds of mouth parts of insects
- Study of following insect vectors through permanent slides/ photographs:
- *Aedes*, *Culex*, *Anopheles*, *Pediculus humanus capitis*, *Pediculus humanus corporis*, *Phthirus pubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*, through permanent slides/ photographs.
- Study of different diseases transmitted by above insect vectors
- Submission of a project report on any one of the insect vectors and disease transmitted

SUGGESTED READINGS

- *Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK*
- *Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK*
- *Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication*
- *Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell*

SEMESTER II

ZOCH 4: DIVERSITY OF CHORDATA

Theory

Credits: 04

Duration: 60 Clock Hours

Learning Objective: To know the general characters and classification of Chordates and understand the increasing complexity of organization of life from lower to higher chordates.

Learning Outcome: On completion of the course the student should be able to know the general organization of Chordates as a group and know the taxonomy and characteristic features of the various Chordate phyla.

Unit 1: Introduction to Chordates	2
General characteristics and outline classification	
Unit 2: Protochordata	8
General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata (Relevant examples to be discussed)	
Unit 3: Origin of Chordata	3
Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata	
Unit 4: Agnatha	2
General characteristics and classification of cyclostomes up to class	
Unit 5: Pisces	8
General characteristics of Chondrichthyes and Osteichthyes, classification up to Order, Migration, Parental care in fishes, Swim bladder, Introduction to Latimeria and Dipnoi.	
Unit 6: Amphibia	6
Origin of <i>Tetrapoda</i> , General characteristics and classification of Amphibia up to order, Parental care in Amphibians, Paedogenesis.	
Unit 7: Reptilia	10
General characteristics and classification of living reptiles up to order; Mesozoic reptiles, Vacuities and arcades in reptilian skull, Venomous and non-venomous snakes.	

Unit 8: Aves**09**

General characteristics and classification up to order, *Archaeopteryx*-- a connecting link; Volant adaptations and Migration in birds. Flightless birds

Unit 9: Mammals**12**

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages, Dentition in mammals.

PRACTICALS**Credits 02**

- **Protochordata**
 - Study of specimens: *Balanoglossus*, *Herdmania*, *Branchiostoma*, *Salpa*, *Doliolum*, *Oikopleura*, *Botryllus*
- **Agnatha**
 - Study of specimens: *Petromyzon*, *Myxine*
- **Fishes**
 - Study of specimens: *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/ Diodon*, *Anabas*, *Cyannoglossus*.
- **Amphibia**
 - Study of specimens: *Ichthyophis/Ureotyphlus*, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*
- **Reptilia**
 - Study of specimens: *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus*.
 - Key for Identification of poisonous and non-poisonous snakes
- **Aves**
 - Study of six common birds from different orders. Types of beaks and claws
- **Mammalia**
 - *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Erinaceus*.

Note: For Classification follow "Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press"

SUGGESTED READINGS

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub Co.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

SEMESTER II

ZOCH 5: PRINCIPLES OF GENETICS

Theory

Credits: 04

Duration: 60 Clock Hours

Learning Objective: To understand the concepts in genetics.

Learning Outcome: On completion of the course the student should be able to know the pattern of inheritance of genetic traits, mutations and chromosomal abnormalities.

Unit 1: Mendelian Genetics and its Extension **08**

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping **12**

Linkage and crossing over, Cytological basis of crossing over, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Unit 3: Mutations **10**

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Types of mutagens, Detection of mutations: CLB method, attached X method. Teratogens.

Unit 4: Sex Determination **04**

Sex determination in animals: Environmental, chromosomal, genic balance

Unit 5: Extra-chromosomal Inheritance **06**

Criteria for extra-chromosomal inheritance, Mitochondrial mutations in *Saccharomyces*, Infective heredity in *Paramecium* and Maternal effects, Milk factor in mice

Unit 6: Polygenic Inheritance **02**

Polygenic inheritance with suitable examples.

Unit 7: Transposable Genetic Elements **08**

Transposons in bacteria, Ac-Ds elements in maize and P elements in

Drosophila, Transposons in humans

Unit 8: Human Genetics

10

Eugenics, Pedigree construction and analysis (Inheritance pattern of sex linked, autosomal dominant and recessive traits), Study of Human chromosomal disorders: Down's syndrome, Klinefelter's syndrome, Turner's, Philadelphia syndrome.

PRACTICALS

Credits 2

- To study the Mendelian laws and gene interactions (Punnet crosses, using beads)
- Linkage maps based on data from *Drosophila* crosses.
- Study of human karyotype: Normal male and female, Down's syndrome, Klinefelter's syndrome
- Pedigree construction
- Pedigree analysis of Human inherited traits
- Effect of UV on bacteria survival
- *Drosophila* culture technique
- Study of *Drosophila* mutants

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings
- Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Fletcher H. and Hickey I. (2015). *Genetics*. IV Edition. GS, Taylor and Francis Group, New York and London

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SEMESTER II

ZOCH 6: PRINCIPLES OF ECOLOGY

Theory

Credits: 04

Duration: 60 Clock Hours

Learning Objective: To understand the concepts in ecology.

Learning Outcome: On completion of the course the student should know the components of ecosystem, their interactions, dynamics and application of this knowledge in wildlife conservation.

Unit 1: Introduction to Ecology	06
History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors	
Unit 2: Population structure and attributes	09
Unitary and Modular populations Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion	
Unit 3. Population dynamics	12
Exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses.	
Unit 3: Community	12
Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession, Theories pertaining to climax community.	
Unit 4: Ecosystem	15
Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with one example of Nitrogen cycle, Human modified ecosystem	

Unit 5: Applied Ecology

06

Ecology in Wildlife Conservation and Management: Carrying capacity of Wildlife habitat.
Habitat management as a conservation approach, Conservation assessment based on species population dynamics

PRACTICALS

Credits 2

- Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
- Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
- Study of an aquatic ecosystem:
 - measurement of temperature,
 - turbidity/penetration of light,
 - determination of pH,
 - Dissolved Oxygen content (Winkler's method),
 - Salinity,
 - Hardness of water
 - CO₂ estimation
- Estimation of organic content of soil.
- Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary

SUGGESTED READINGS

- *Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.*
- *Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.*
- *Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole*
- *Robert Leo Smith Ecology and field biology Harper and Row publisher*
- *Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres*
- *Trivedi and Goel Physico-chemical and Biological methods of water and soil analysis., Karad publications.*
- *Rajesh Gopal (2000). Fundamentals of Wildlife Management., Justice Home publishers.*
- *Singh S.K., (2005), Textbook of Wildlife Management., IBDC publications*
- *Verma P.S. and Agrawal B.K. (2002), Environmental Biology (principles of Ecology). S. Chand publications.*
- *Poddar T. and Mukhopadhyay and Das S.K. (2003) An advance laboratory manual of Zoology. McMillan India Ltd. Mumbai.*

SEMESTER II

GEH 2A: WILDLIFE AND ECOTOURISM

Theory

Credits: 03

Duration: 45 clock hours

Learning Objective: To learn the objectives and strategies of wildlife conservation and monitoring.

Learning Outcome: On completion of the course the student should be able to know the current status and conservation strategies for wildlife conservation and management.

Unit1: Introduction to Wildlife, Current Scenario & Conservation categories. 04

Meaning, Values, Global & Indian scenario

Biogeographic zonation and wildlife endowments of India, Wildlife as a sustainable tourism resource.

Contemporary status of Indian Wildlife and Impediments to conservation of wildlife in India

Unit2: Causes of depletion, extinction of wildlife & Conservation Categories 10

Causes of Wild Depletion -Proximate & Root causes.

Extinct Species, Drivers of Extinction & Extinction Threshold

North East and Western Ghats; as 'Centers of Endemicity'

Conservation categories with relevant examples (Endangered, Vulnerable, Rare, Threatened, Out of Danger, Indeterminate, Insufficiently Known, Extinct, Extinct in Wild ,Critically Endangered, Lower Risk, Conservation Dependent, Near Threatened, Least Concern, Data Deficient, Not Evaluated)

IWPA 1972, Schedule I species (Mammals, Birds and Reptiles).

Unit 3: Wildlife Conservation-Objectives & Methods 06

Meaning of conservation,

Objectives of wildlife conservation

Conservation strategies, *Ex situ* & *In situ* methods of wildlife Conservation (PAN, CCA, Zoos, Aquaria, Captive Breeding & Ranching etc)

Centrally Sponsored Schemes for Wildlife Conservation (Integrated Development of Wildlife Habitats, Project Tiger, Project Elephant)

Unit 4: Wildlife Tourism in India: Prospects & Challenges 10

Difference between Tourism, leisure and recreation

Ecotourism versus Conventional Mass tourism, a SWOT analysis.

Natural area Tourism (Adventure tourism, Wildlife tourism and Ecotourism)

Wildlife Tourism: **Advantages** (Sustainability of enterprise, Assured backflow of profits to local communities, Upholding conservation ethos)

Wildlife Tourism: **Impacts** (Altered landscape, Impact of roads on wildlife habitats, , Tourism generated litter, Introduction of Invasive species, Zoonotic disease transmissions, Violation of 'Visitors carrying Capacity' & visitor induced stress and disturbance Tour to wildlife)

Unit 5: Planning, Management & Monitoring of Wildlife Tourism

15

Wildlife as a specific component of ecosystem and major wildlife destinations in India.(Wildlife of Indian Himalayas, Indian Deserts, Indian Coral Reefs, Western Ghats)

Rationale for Visitor Planning and stakeholder involvement

Carrying Capacity & 'Acceptable' Change

Visitor Management: Zoning, Roads & Trails, Regulating Visitor numbers, Visitor Communication & Education.

Interpretation: Fundamental Principles & major interpretation techniques (Publication & Websites, Visitor Centres, Self-guided Trails, Guided Tours

Visitor Monitoring: Reasons for Monitoring, Monitoring Techniques (Counting visitors, Questionnaires & Interviews, Observing visitors, Focus Groups)

Practical

Credits 1

- Use of Maps and other GIS resources to understand the biogeographic zones of India and understand the location of our State in this scheme.
- Prepare an Inventory of state's Wildlife Resources (Forest Types, Carnivores, Wild Ungulates, Birds, Reptiles) from secondary sources and classify them under them under various PAN, IUCN conservation categories & IWPA Schedule.
- Visit to a state WPA and CCA to understand and prepare Report on the management and conservation action.
- To prepare an inventory of your Taluk's existing and potential Ecotourism sites with special reference to Birdlife. Evaluate any one extant ecotourism site with reference to:
 - Visitor's Carrying Capacity
 - Visitor Education & Interpretation
 - Visitor Facility
- Observing the effect Habitat improvement on diversity of butterflies (Diversity estimation pre and post food plants introduction
- Understanding Carnivore Pug Biometry by analysis of Pug Marks/Whisker Spot study in Asiatic Lion (Printed Lion Pug Imprints / Lion Head sketches with Reference Rows & Identification Rows of Whisker Spots to be provided)
- Population enumeration by Lincoln & Peterson's Index Method (Coloured Beads to represent marked to unmarked individuals)

Reference Books

- S K Singh (2010) *Text Book of wildlife Management* International Book Distributing Company, Lucknow
- Vivek Menon (2014) *Indian Mammals :A Field Guide* Hachette Book Publishing India Pvt Ltd, Gurgaon
- S S Negi (1992) *Himalayan Wildlife*. Indus Publishing Company, New Delhi

- Mohan Pai (2005) *The Western Ghats*. M/S Narcinva damodar Naik Margao ,Goa
- Richard Carmichael (2007). *Indian Wildlife*. Apa Publications GmbH Co. Vertag KG (Singapore)
- Ravee Chauhan (2006) *Ecotourism Trends & Challenges*. Vista International Publishing House Delhi
- David Newsome, Susan Moore and Ross K Dowling (2006) *Natural Area Tourism Ecology, Impacts and Management*. Viva Books Pvt Ltd Ac Delhi
- C.Michael Hall and Stephen Boyd (2006) *Nature based tourism in peripheral areas - Development or disaster ?* Viva Books Pvt Ltd New Delhi
- Ministry of Environment & Forests GoI, (2002), *National Biodiversity Strategy & Action Plan*
- Willian J. Sutherland, Lynn V. Dicks, Nancy Ockendon & Rebecca K. Smith(2015) *What works in conservation*. Open Book Publishers, UK
- S K Singh (2010) *Text Book of wildlife Management* International Book Distributing Company, Lucknow
- Paresh Porb, Raman Kulkarni and Varad Giri (2014) *Biodiversity of Goa*. Pug Marks Art Gallery, Kolhapur
- Goa State Biodiversity Board (2014) *Island Biodiversity , Goa:Biological Treasure of Chora, Divar and St Jacinto Island*. National Biodiversity Authority.
- Richard Grimmet, Tim Inskipp (2005) *Birds of Southern India*. Om Books International Issac Kehimkar (2011) *The Book of Indian Butterflies*. Oxford.
- Luigi Boitani & Roger Powell (2012) *Carnivore Ecology and Conservation*. Oxford University Press
- Romulus Whitaker & Ashok captain (2008) *Snakes of India*. Draco Books Tamil Nadu
- Asad R Rehmani (2012) *Threatened Birds of India*. Oxford University Press
- Ravee Chauhan (2006) *Ecotourism Trends & Challenges*. Vista International Publishing House Delhi
- David Newsome, Susan Moore and Ross K Dowling (2006) *Natural Area Tourism Ecology, Impacts and Management*. Viva Books Pvt Ltd Ac Delhi
- *The Wildlife (Protection) Act, (1972)* Natraj Publishers.

SEMESTER II

GEH 2B: POULTRY SCIENCE

Theory

Credits: 03

Duration: 45 clock hours

Learning Objective: To learn the knowhow of rearing poultry birds.

Learning Outcome: On completion of the course the student should be able to understand the various aspects of rearing poultry birds and their commercial importance.

Unit 1: Poultry production and breeding

6

Present status of poultry products technology in India and its scope for expansion and future development. Principles of poultry breeding, Management of breeding stock and broilers, Selection and culling of birds.

Unit 2: Poultry live stocks

18

Identification of poultry birds. Housing of poultry birds. Care and health cover of chicks, pullets, layers and broilers. Feeding, digestion, assimilation, growth and reproduction of poultry birds.

Unit 3: Poultry nutrition

11

Types of poultry feeds, Important ingredients of poultry feeds: important macro and micro nutrients, feed supplements and feed additions.

Methods of measuring feed values and computation of ration for different stocks, measurement of least cost ration, techniques of feed preservation

Unit 4 : Poultry products and technology

10

Egg and poultry meat as a source of quality animal protein. Collection, sorting, processing and preservation of eggs. Egg quality and its maintenance. Sources of contamination of egg and its prevention. Principles of dressing poultry including chilling, packing and labeling. Different methods of preservation of poultry meat- chilling, freezing, curing, smoking, dehydration and canning. Microbial spoilage of poultry meat and its prevention.

PRACTICALS

Credits: 01

- Identification and classification of poultry birds as chicks, pullets, layers and broilers.
- Fabrication of poultry cages
- Identification of poultry feeds
- Measurement of nutrient value of egg (protein, cholesterol, Lecithine, total fat)
- Feed preservation techniques.
- Evaluation of poultry feed.
- Study of nematode/Cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product]
- study of reproductive system of poultry birds

- Visit to poultry farm. Submission of visit report

References:

- McDonald, P., Edwards, R. A., Greenhalgh, J. F. D. & Morgan, C. A. (2002). *Animal Nutrition*, 6th ed. Edinburgh, UK: Pearson Education Ltd.
- Scanes, C. G., Brant, G. & Ensminger, M. E. (2004). *Poultry Science*, 4th ed. New Jersey, USA: Pearson/Prentice Hall.
- Winston and Winston (2003) *Poultry*. Agrobios, India
- Jagdish Prasad. *Poultry production and Management*. Kalyani publishers, Ludhiana.
