POST GRADUATE DEPARTMENT OF ZOOLOGY

DARJEELING GOVERNMENT COLLEGE

(UNIVERSITY OF NORTH BENGAL)

SYLLABUS OF M.Sc. COURSE IN ZOOLOGY

SEMESTER SYSTEM

(C.B.C.S.)

2022

DARJEELING GOVERNMENT COLLEGE

19 – LEBONG CART ROAD

DARJEELING - 734101

Darjeeling Government College
Post Graduate Department of Zoology
Semester-wise distribution of course

Semester	Courses	Marks	Lecture Hours	Credits
1st semester	1. Core course 2. Discipline Specific Elective 3. Ability Enhancement course	400	544	16
2nd semester	1. Core course 2. Discipline Specific Elective 3. Skill Enhancement Course	400	544	16
3rd semester	1. Core course 2. Discipline Specific Elective 3. Generic Elective 4. Ability Enhancement course	400	544	16
4th semester	1. Core course 2. Discipline Specific Elective 3. Generic Elective 4. Skill Enhancement Course	400	544	16
Total		1600	2176	64

P.G. SYLLABUS IN ZOOLOGY AS PER CBCS PATTERN – 2022

Orientation of courses in four semesters

FIRST SEMESTER:

Sem	Crs	Course	New Course-Code (ALPHA- NUMERIC)	Course Type	Paper Type	Course Name	Full Marks (External)	Full Marks (Practical)	Full Marks (Internal)	Total FM	Credit	Paper Sequence
1	330	**ZOOLOGY**	DZOOCCT0101N	**Core**	T	Functional Biology of Non-chordates and Chordates	42		8	50	2	1
			DZOOCCT0102N			Ecology and Biodiversity	42		8	50	2	2
			DZOOCCT0103N			Developmental Biology and Endocrinology	42		8	50	2	3
			DZOOCCP0104N		P	Functional Biology of Non-chordates and Chordates		50		50	2	4
			DZOOCCP0105N			Ecology, Biodiversity and Developmental Biology		50		50	2	5
			DZOOCCP0106N			Seminar Presentation		25		25	1	6
			DZOOCCP0107N			Review of a Scientific Paper		25		25	1	7
			DZOODET0101A	**DSE (Any one)**	T	Insect Biology	42		8	50	2	8
			DZOODET0101B			Aquaculture						
			DZOODET0101C			Climate Change Biology						
			DZOODET0101D			Cellular Organization, Communication and Signalling						
			DZOODET0101E			Parasitology and Medical Entomology						
			DZOODET0101F			Ornamental Fish Culture						
			DZOOAUT0101	**AEC (Any one)**	T	*Paper to be selected from NBU basket*	50			50	2	9
						TOTAL	**218**	**150**	**32**	**400**	**16**	

SECOND SEMESTER:

Sem	Crs	Course	New Course-Code(ALPHA-NUMERIC)	Course Type	Paper Type	Course Name	Full Marks (External)	Full Marks (Practical)	Full Marks (Internal)	Total FM	Credit	Paper Sequence
2	330	**ZOOLOGY**	DZOOCCT0201N	**Core**	T	Cell Biology and Biochemistry	42		8	50	2	1
			DZOOCCT0202N			Taxonomy and Biostatistics	42		8	50	2	2
			DZOOCCT0203N			Parasitology and Immunology	42		8	50	2	3
			DZOOCCP0204N		P	Cell Biology and Biochemistry		50		50	2	4
			DZOOCCP0205N			Taxonomy, Biostatistics and Parasitology		50		50	2	5
			DZOOCCP0206N			Scientific Excursion		50		50	2	6
			DZOODET0201A	**DSE (Any one)**	T	Taxonomy and Anatomy of Insects	42		8	50	2	7
			DZOODET0201B			Taxonomy and Physiology of Fishes						
			DZOODET0201C			Environmental Protection and Sustainability						
			DZOODET0201D			Intracellular Protein Trafficking and Cancer Biology						
			DZOODET0201E			Medical Protozoology						
			DZOODET0201F			NCC						
			DZOODET0201G			NSS						
			DZOODET0201H			MOOCS						
			DZOOSFT0201	**SEC (Any one)**	T	*Paper to be selected from NBU basket*	42		8	50	2	8
						TOTAL	**210**	**150**	**40**	**400**	**16**	

THIRD SEMESTER:

Sem	Crs	Course	New Course-Code (ALPHA- NUMERIC)	Course Type	Paper Type	Course Name	Full Marks (External)	Full Marks (Practical)	Full Marks (Internal)	Total FM	Credit	Paper Sequence
3	330	**ZOOLOGY**	DZOOCCT0301N	**Core**	T	Biotechnology and Biophysical Technique	42		8	50	2	1
			DZOOCCP0302N		P	Biotechnology and Biophysical Technique		50		50	2	2
			DZOODET0301A	**DSE (Any Three)**	T	Physiology of Insects	42+42+42		8+8+8	150	6	3,4,5
			DZOODET0301B			Environmental Entomology						
			DZOODET0301C			Pest and Vector Biology						
			DZOODET0301D			Fish Behaviour and Reproduction						
			DZOODET0301E			Fisheries Management						
			DZOODET0301F			Practices and Economy of Fisheries						
			DZOODET0301G			Ecosystem: The Basic Unit of Natural World						
			DZOODET0301H			Environmental Resources: Issues, Management and Solution for Sustainability						
			DZOODET0301I			Environmental Pollution and Prevention						
			DZOODET0301J			Quantitative and Human Genetics						
			DZOODET0301K			Genome Analysis and Mapping Strategies						
			DZOODET0301L			Protein-nucleic acid interaction and Genetic Engineering						
			DZOODET0301M			Helminthology						
			DZOODET0301N			Applied Immunology						
			DZOODET0301O			Parasitology						
			DZOOGET0301A	**GE (Any one)**	T	Wildlife Biology	75		25	100	4	6
			DZOOGET0301B			Ethology						
			DZOOAUT0301	**AEC (Any one)**	T	*Paper to be selected from NBU basket*	50			50	2	7

						TOTAL	**293**	**50**	**57**	**400**	**16**	

FOURTH SEMESTER:

Sem	Crs	Course	New Course-Code (ALPHA-NUMERIC)	Course Type	Paper Type	Course Name	Full Marks (External)	Full Marks (Practical)	Full Marks (Internal)	Total FM	Credit	Paper Sequence
4	330	**ZOOLOGY**	DZOOCCT0401N	**Core**	T	Inheritance Biology and Evolutionary Genetics	42		8	50	2	1
			DZOOCCT0402N			Environmental Physiology and Neurobiology	42		8	50	2	2
			DZOOCCP0403N		P	Project/Dissertation/Review		50		50	2	3
			DZOOCCP0404N			Seminar Presentation (based on Project/Dissertation/Review)		25		25	1	4
			DZOOCCP0405N			Comprehensive Viva		25		25	1	5
			DZOODEP0401A	**DSE (Any one)**	P	Entomology Practical		50		50	2	6
			DZOODEP0401B			Fisheries Practical						
			DZOODEP0401C			Environmental Biology Practical						
			DZOODEP0401D			Cytogenetics Practical						
			DZOODEP0401E			Parasitology Practical						
			DZOOGET0401A	**GE (Any one)**	T	Conservation Biology	75		25	100	4	7
			DZOOGET0401B			Elementary Human Physiology						
			DZOOSFT0401	**SEC (Any one)**	T	*Paper to be selected from NBU basket*	42		8	50	2	8
						TOTAL	**201**	**150**	**49**	**400**	**16**	

COURSE CODE, NAME AND SYLLABI

FIRST SEMESTER:

CORE COURSE (THEORY)

DZOOCCT0101N : Functional biology of Non-chordates and Chordates

L.H.=68 ; Credit: 02 ; FM= 50

Non-chordates

1. Nutrition and digestion:
   a. Patterns of feeding and digestion in lower metazoan.
   b. Filter-feeding in Polychaeta, Mollusca and Echinodermata.
2. Respiration:
   a. Organs of respiration: Gills, Book-lungs and Trachea.
   b. Respiratory pigments.
   c. Mechanism of respiration.
3. Excretion:
   a. Organs of excretion.
   b. Mechanism of excretion.
   c. Excretion and Osmoregulation.
4. Nervous system: Trends in neural evolution.
   a. Primitive
   b. Advanced
5. Invertebrate larvae: Strategies and evolutionary significance of larval forms.

Chordates

1. Integuments and its derivatives:
   a. General structures of integument.
   b. Functions of integumentary derivatives.
2. Circulation: Evolution of aortic arches and portal system.
3. Evolution of Urinogenital system in vertebrate series.
4. Nervous system and sense organs:
   a. Organs of olfaction and taste.
   b. Lateral-line system.
   c. Electroreception.

SUGGESTED BOOKS:

Non-Chordates:

1. Invertebrate Zoology : R. D. Barnes
2. Invertebrate Zoology : Ruppert and Barnes
3. Biology of Invertebrates : J. A. Pechenik
4. Invertebrate Zoology : Anderson
5. Invertebrate structure and functions : Barrington E J W, Thomas Nelson and Sons Ltd., London
6. Biology of Higher Invertebrates : Russel – Hunter, W.D. The Macmillan Co. Ltd.
7. Biology of Animal Parasites : T. C. Cheng
8. Annelids : R. P. Dales
9. The Invertebrates Vol. I – VI : L. H. Hyman
10. Invertebrate Zoology : P. A. Meglitsch
11. Invertebrate Zoology : Meglitsch and Schram
12. Textbook of Zoology : Marshall and Williams
13. The Biology of Protozoa : M. Sleigh
14. Insect Physiology : V. B. Wigglesworth
15. Invertebrates- Richard C. Brusca, Garry T. Brusca, Sinauer Associates Inc; Publishers, Massachusetts

Chordates:

1. The Life of Vertebrates : J. Z.Young
2. Analysis of Vertebrate Structure : M. Hilderbrand
3. Biology of Vertebrates : Walter & Sayles
4. Anatomy of the Chordates : C. K.Weichert
5. Vertebrate Life Pough, Heiser and Mc Farland
6. Chordate structure and function : Klugg
7. Outline of comparative anatomy of vertebrates : Kingsley, J.S.
8. Comparative anatomy of the vertebrates : Kent
9. The Chordates : R. M. N. Alexander
10. Vertebrate Comparative Anatomy, Functions, Evolution : K. V. Kardong
11. Vertebrate Body : Romer

DZOOCCT0102N : Ecology and Biodiversity L.H.=68 ; Credit: 02 ; FM= 50

Ecology

1. Population Growth
   a. Life tables.
   b. Reproductive rate.
   c. Deterministic model and Stochastic model.
2. Population Regulation
   a. Allee effects.
   b. Regulating factors: Density dependent, Density independent, Limiting factor.
3. Metapopulation
   a. Dynamics.
   b. Patch size and density.
   c. Local population demography.
   d. Level of genetic variation.
4. Competition and Co-existence
   a. Species interaction.
   b. Intraspecific competition.
   c. Interspecific competition.
   d. Co-existence.
5. Agroecology and Ecological Restoration

Biodiversity

1. Evaluation of different biodiversity indices:
   a. Diversity indices.
   b. Similarity and dissimilarity index.
   c. Association index.
2. Biodiversity basic concepts:
   a. α, β, γ diversity
   b. Regional aspects and diversity
   c. Hotspots and mega diversity centers.
   d. Biodiversity status, monitoring and documentation.
   e. Values of biodiversity.
   f. Uses of biodiversity.
3. Global pattern of biodiversity
   a. Diversity in biogeographical region and marine zones.
   b. Diversity clines in relation to area, latitude, altitude and deep sea.
   c. Theories on biodiversity dispersions.
4. Agrobiodiversity and centers of origin.

SUGGESTED BOOKS:

Ecology:

1. Fundamentals of Ecology : Odum
2. Ecology : Krebs
3. Ecology : Riclefs and Miller
4. Fundamentals of Ecology : Dash
5. Environmental Science : Wright
6. Ecology : Begon Harper
7. Ecological theories and applications : Peter Stiling

Biodiversity:

1. Biodiversity : Krishnamoorthy Oxford & IBH Pub.Co.
2. Biodiversity : Ashija & Kumar Agrobios.
3. Biodiversity : Swaminathan Macmillan India Ltd.
4. Ecology : Chapman and Reiss Cambridge Low Priced Edition
5. Ecology : Ricklefs and Miller

DZOOCCT0103N : Developmental Biology and Endocrinology

L.H.=68 ; Credit: 02 ; FM= 50

Developmental Biology

1. Gametogenesis:
   a. Spermatogenesis: Introduction, features, stages, mature sperm production and structure, biochemistry of semen, hormonal control.
   b. Oogenesis: Introduction, features, phases, mature ova production, structure and fate, ovulation, vitellogenesis, hormonal control.
2. Fertilization:
   a. Pre-fertilization events.
   b. Biochemistry of fertilization.
   c. Post-fertilization events.
3. Events of cleavage, blastulation and gastrulation as found in chick embryo.
4. Regenerative biology.
5. HOX gene and their regulation.

Endocrinology

1. Aims and Scope of Endocrinology:
   a. Hormones as messengers.
   b. Hormone and metabolic regulation; regulation of calcium homeostasis.
   c. Classification and chemical nature of hormones.
2. Nature of hormone action: Hormone receptors, membrane receptors, G proteins, nuclear receptors.
3. Neuroendocrine regulation.
4. Ultrastructure and functions of:
   a. Pituitary gland.
   b. Thyroid gland.
   c. Endocrine Pancreas.
   d. Adrenal gland.
   e. Testis.
   f. Ovary.

SUGGESTED BOOKS:

Developmental Biology:

1. Introduction to Embryology : Balinsky
2. Developmental Biology : Berril
3. Biology of Developmental System : Grant
4. Reproduction in Animals : Austin and Short
5. Molecular Biology of Fertilization : Schatten and Schatten
6. Human Reproduction : R. G.Edwards
7. Embryology : S. F.Gilbert
8. Molecular Cell Biology : Harvey, Baltimore, Arnold, Zipursky, Matsudaria and Darnell
9. Biological Development : Kalthoff
10. Developmental Biology : Wolpart
11. Developmental Biology : S. Chattopadhyay. Books and Allied.
12. Fertilization : Longo, F.T.

Endocrinology:

1. General and Comparative Endocrinology : E. J. W.Barrington
2. Endocrine Physiology : C. R. Martin -Oxford
3. Comparative Endocrinology : A. Gorbman
4. General Endocrinology : Turner and Bagnara
5. Essential Endocrinology : Brook and William
6. Comparative Endocrinology : Norris
7. Experimental Endocrinology : M. X. Zarrow
8. Endocrinology : MacHadley
9. Endocrinology : Greenspan

CORE COURSE (PRACTICAL)

DZOOCCP0104N : Non-chordates and Chordates L.H.=102 ; Credit: 02 ; FM= 50

1. Major Dissection (As specimen available at the market or from laboratory specimens):
   a. Nervous system of Earthworm.
   b. Corpora allata and corpora cardiaca of Cockroach.
2. Mounting / Minor dissection (As specimen available at the market or from laboratory specimens):
   a. Nephridium and spermatheca in Earthworm.
   b. Setae of Earthworm, Mouth parts of honey bee or mosquito or housefly.
3. Identification with reason upto subclasses /order:
   a. Protozoa: *Opalina, Balantidium, Nyctotherus*.
   b. Porifera: Neptune's cup, *Scypha* sp.
   c. Coelenterata: *Physalia, Aurelia, Pennatula*.
   d. Helminths: Microfilaria of *W. bancrofti, Echinococcus, Anchylostoma*.
   e. Annelida: *Aphrodite, Sabella.*
   f. Arthropoda: *Sacculina, Mantis*, Stick insect.
   g. Mollusca: *Loligo, Sepia, Doris*, Pearl oyster.
   h. Echinodermata: Sea star, Brittle star.
4. Major Dissection (As specimen available at the market):
   a. V th and VII th cranial nerves in *Gallus* sp.
   b. Location and extraction of pituitary gland of carp.
5. Mounting / Minor dissection (As specimen available at the market):
   a. Weberian ossicles and swim bladder in carp.
   b. Cycloid / Ctenoid / Placoid scales offish.
6. Identification with reason upto subclasses /order:

   Balanoglossus, Doliolum, Salpa, Sucker fish, Flying fish, Sea horse, *Labeorohita, Labeobata, Catlacatla, Siren, Tylototritonverrucosa, Mabuya, Chelone, Scinctillasikkimensis, Javaluraverrucosa*, Pangolin, Megachiropteran bat, Microchiropteran bat.

DZOOCCP0105N : Ecology, Biodiversity and Developmental Biology

L.H.=102 ; Credit: 02 ; FM= 50

1. Study of species diversity index – Shannon index, Richness index, Relative abundance, Species evenness, Importance value index.
2. BOD of water sample.
3. Ecological comments on: blood parasite, gut parasite, flat fish, tree frog, Himalayan bird, mole, hermit crab, *Balanus*, red spider mite, *Helopeltis*, red panda, flying squirrel, Himalayan mouse.
4. Identification of developmental stages of chick embryo and toad embryo.

DZOOCCP0106N : Seminar Presentation **Credit: 01 ; FM= 25**

DZOOCCP0107N : Review of a Scientific Paper **Credit: 01 ; FM= 25**

DSE (THEORY)

DZOODET0101A : Insect Biology

DZOODET0101B : Aquaculture

DZOODET0101C : Climate Change Biology

DZOODET0101D : Cellular organization, communication and signaling

DZOODET0101E : Parasitology and Medical Entomology

DZOODET0101F : Ornamental Fish Culture

DZOODET0101A : Insect Biology **L.H.=68 ; Credit: 02 ; FM= 50**

1. Characters and classification of class Insecta (upto Order).
2. Structure and function---
   a. Cuticle and molting.
   b. Nervous system and compound eyes.
   c. Haemocoel, hemolymph, heart with ostia.
   d. Malpighian tubules and excretion.
   e. Reproductive organs.
3. Endocrine functions---
   a. Chemical nature and function of hormones.
   b. Pheromones.
4. Insect pest and vectors---
   a. Pest status and management.
   b. Vectors and their management- mosquitoes, sand flies, tsetse flies, termites.

SUGGESTED BOOKS:

Insect Biology:

1. Chapman R.F. 2000. The Insect : Structure and Function, 4thEnd. Cambridge Low price End. Cambridge Univ. Press.
2. Chatterjee, P. B. : Plant protection Technique, Bharati Bhawan. (P &D).
3. Dey, S. and Raziuddin, M. : The female reproductive system of aak grasshopper : A histomorphological study. Lambert Academic Publishing.
4. Gullan, P.J. and P.S Cranstor : The Insect: An outline of Entomology, Chapman & Hall.
5. Krebs, C.J. : Ecology, the Experimental analysis of Distribution and Abundance, Harper & Row Publishers.
6. Pedigo, L,P. : Entomology and Pest management, Prentice: Hall of India Pvt.Ltd.
7. Saxena, S.C : Biology of Insects, Oxford and IBH Publishing Co. Pvt.Ltd.
8. Srivastava, K.P. : A test Book of Applied Entomology Vol. I &II, Kalyani Publishers.
9. Tembhre, D. B. : Modern Entomology.
10. Yazdani, S.S, and M.L Agarwal : Element of Insect Ecology, Narosa Publishing House.

DZOODET0101B : Aquaculture **L.H.=68 ; Credit: 02 ; FM= 50**

1. Classification of fishes upto Order.
2. Common (major, minor) and exotic carps.
3. Aquaculture--- monoculture, polyculture and composite fish culture.
4. Prawn and Pearl Culture.
5. Osmoregulation in migratory fishes.
6. Hypophysation, fish processing and economic importance of fishes.

SUGGESTED BOOKS:

Aquaculture:

1. Advances in fish biology : H. R. Singh
2. Air breathing fishes of India : J. S. Dutta Munshi and G. M. Hughes
3. Aquaculture : T. V. R. Pillai
4. Biology of fishes : Bone and Moore
5. Ecology of aquatic system : M. Dobson and C. Frid
6. Fish and fisheries : S. Kumar and M. Tembhre
7. Fish and fisheries : S. S. Khanna
8. Fish and fisheries of India : V. G. Jhingran
9. Fish and fisheries products : FAO
10. Fisheries bioeconomics : FAO
11. Fisheries in India : R. Mitra

DZOODET0101C : Climate Change Biology L.H.=68 ; Credit: 02 ; FM= 50

1. Greenhouse gases and greenhouse effect, ozone layer depletion.
2. Global warming, global patterns of temperature and precipitation, Carbon sequestration, Carbon trading, Carbon foot print.
3. Concept of REDD (reducing emission through destruction and deforestation) and REDD+.
4. Policies initiatives for climate change and conservation.
5. Introduction to Intergovernmental Panel on Climate Change (IPCC) and their reports.
6. El niño, La niña, southern oscillation and their ecological impact.
7. Impact of Climate Change Impact on ecosystem process, the physical environment: glacial melt including glacial retreat in the Himalayas, glacial lake outburst flood (GLOF), sea level rise, landslides, drought, changes in rainfall patterns, snow fall events, coral reef bleaching, etc.

SUGGESTED BOOKS:

Climate Change Biology:

1. IPCC . Fourth assessment report of the Intergovernmental Panel on Climate.
2. Change (IPCC). Cambridge University Press, Cambridge, United Kingdom.
3. General Issues on Environmental Ecology, Bio diversity and Climate change. B. Ramasamy. Pragun Publication.
4. Environment and Ecology: Biodiversity, Climate Change and Disaster Management., M. Hussain, Access Publishing House.
5. The Little Data Book on Climate Change (2011) World Bank Publications.
6. Hand Book of Climate Change Science. S.S. Negi, Bishen Singh Mahendra Pal Singh.
7. The Rough Guide to Climate Change. Rr. Henson, 2011. Rough Guides Publisher.
8. General Issues on Environment, Biodiversity and Climate Change. R. Kaur 2014, New Vishal Publication.
9. Global Carbon Cycle and Climate Change. K.Y. and Kondratyev, V. F. Krapivin. 2014, Springer Publications.
10. Remote Sensing in Snow Hydrology: Runoff Modelling, Effect of Climate Change., K. Seidel and J. Martinec, 2014. Springer publications.
11. Preparing for Climate Change. M.D. Mastrandrea and S.H. Schneider, 2010. MIT Press.

DZOODET0101D : Cellular organization, communication and signaling

L.H.=68 ; Credit: 02 ; FM= 50

1. Structure and function of cytoskeleton and its role in motility.
2. Membrane protein diffusion, osmosis, ion-channels, active transport, membrane pump.
3. Regulation of hematopoiesis, general principles of cell communication. Cell adhesion and roles of different adhesion molecules, gap junction.
4. Extracellular matrix, structure and function of Integrins. Collagens and non-collagen components.
5. Cell surface receptors. Signaling through G-protein coupled receptor. Cross talk between signal transduction pathways.
6. Secondary messenger system, MAP Kinase pathway.

SUGGESTED BOOKS:

Cellular organization, communication and signaling:

1. Cell Biology : Alberts et.al.
2. Cell Biology : Lodish
3. Cell Biology : Becker et.al.
4. Molecular Biology of the Gene : Watson
5. Cell Biology : Pollard and Earnshaw
6. Cell : A Molecular Approach : Cooper
7. Molecular Biology : Karp

DZOODET0101E : Parasitology and Medical Entomology

L.H.=68 ; Credit: 02 ; FM= 50

Parasitology

1. Life history and pathogenicity of: *Entamoeba, Giardia.*
2. Life history, physiology and biochemistry of malarial parasites.
3. Life cycle, transmission and pathogenicity of: *Trypanosoma, Leishmania.*
4. Life cycle and control of: *Schistosoma* sp., *Taenia* sp., *Wuchereria* sp., *Dracunculus* sp., *Ascaris* sp.

Medical Entomology

1. Importance in disease transmission of Culicidae, Simuliidae, Tabanidae, Phlebotomidae.
2. Arthropods as ectoparasites – Pediculidae, Ixodidae and Argasidae.
3. Myiasis – causative agents, types and pathogenicity.

SUGGESTED BOOKS:

Parasitology and Medical Entomology:

1. Parasitism : The Diversity and Ecology of Animal Parasites : Bush and Fernandez
2. Veterinary Parasitology – Reference Manual : William J. Foreyt
3. Practical Exercises in Parasitology : Halton, Behnke and Marshall
4. Illustrated guide to Protozoa : Leedale, Bradbury, Lee and Soldo
5. Biology of Parasitism : Tschudi and Pearce
6. Protocols in Protozoology : Lee and Soldo
7. The Biology of Nematodes : Donald L. Lee

DZOODET0101F : Ornamental Fish Culture L.H.=68 ; Credit: 02 ; FM= 50

1. **Aquarium Construction:**

a. Ornamental fish culture as hobby.
b. Design and construction of different types of aquarium.
c. Selection of suitable species and species combination.
d. Use of aerators, filters, lights, etc.

2. **Aquarium Management:**

a. Water quality management and maintenance of aquarium.
b. Aquarium plants and their propagation; control of algal growth.

3. **Taxonomy and Biology of Ornamental fishes:**

a. Fresh water ornamental fishes--- Live bearers, Gold fish, Koi carp, Gourami, Barbs, Tetras, cichlids.
b. Marine ornamental fishes--- Damselfish, Clownfish.

4. **Ornamental fish breeding:**

a. Breeding and rearing of ornamental fishes.
b. Management practices of ornamental fish farm.
c. Handling, packing, transport of fishes and quarantine method.
d. Trade regulation and wild act in relation to ornamental fishes.

5. **Diseases of ornamental fish:**

a. Common diseases of ornamental fishes and their control--- itch disease, tail and fin rot, dropsy, Trichodiniasis, Argulosis, Gyrodactylosis, Dactylogyrosis, gas bubble disease.

6. **Continuing Evaluation**

SUGGESTED BOOKS:

1. A.D. Dholakia. 2016. Ornamental Fish Culture and Aquarium Management.
2. A.Sinha. 2021. Breeding and Culture of Freshwater Ornamental Fish.
3. Harishankar J. Alappat, A. Biju Kumar. 2011. Aquarium Fishes: A Colourful Profile.
4. S.K. Swain, N. Sarangi, S. Ayyappan. 2010. Ornamental Fish Farming.
5. S. Felix, T.V. Anna Mercy, S.K. Swain. 2013. Ornamental Aquaculture: Technology and Trade in India.
6. B.K. Mahapatra, S. Dutta, G.H. Pailan, P. Sardar, A.R. Sen, S. Dasgupta. 2015. Ornamental Fish Breeding, Culture and Trade.

AEC

To be selected from NBU basket.

SECOND SEMESTER:

CORE COURSE (THEORY)

DZOOCCT0201N : Cell Biology and Biochemistry L.H.=68 ; Credit: 02 ; FM= 50

Cell Biology

1. Biomembranes:
    a. Molecular composition and arrangement functional consequences.
    b. Transport across cell membranes – Diffusion, active transports and pumps, uniport, symport and antiport.
    c. Membrane potential.
    d. Co-transport by symporters or antiporters.
2. Cytoskeleton:
    a. Microfilaments and microtubules – structures and dynamics.
    b. Cell movements – intracellular transport, role of kinesin and dynein, signal transduction mechanisms.
3. Cell cycle:
    a. Cyclines and cycline dependent kinases.
    b. Regulation of CDK-Cycline activity.
    c. Initiation and inhibition of cell cycle.
4. Cell Death mechanism: Basic concepts.
5. Genetic code:
    a. Degeneracy of the code: Wobble hypothesis and iso-acceptor tRNAs.
    b. Special features of the genetic code in mitochondria, mitochondrial tRNA.
    c. Point mutations that alter genetic code (missense, nonsense &frameshift).
    d. Suppressor mutation, suppressor genes & suppressor tRNA.

Biochemistry

1. Biomolecules and Bio molecular interaction:
    a. Water as ideal biological solvent.
    b. Basic concept of pH, normality, morality, molality, osmolality.
    c. Characteristic features of van-der Waal's interaction, Hydrogen Bond, Co-valent bond, Non-covalent bond.
2. Protein folding and protein stability, Ramachandran plot.
3. Enzymology:
    a. Kinetic analysis of enzyme-catalyzed reaction.
    b. Regulation of enzyme activity.
    c. Mechanism of enzyme catalysis, isozymes, co-enzymes.

4. Bioenergetics: Thermodynamic principles and steady-state conditions of living organism.

5. Biotransformation: Cytochrome P450; Nomenclature and Isoforms, properties and physiological function, Induction and Inhibition, Drug-drug interactions and adverse effects.

SUGGESTED BOOKS:

Cell biology:

1. Molecular Cell Biology : J. Darnell et.al.
2. Molecular Biology of the Cell : Alberts et.al.
3. Cell Biology : Cooper
4. Cell and Molecular Biology : De Robertis and De Robertis
5. Molecular Cell Biology, Lodish et.al., Scientific American Book Inc. USA.
6. Cell and Molecular Biology, G. Karp, John Wiley and Sons
7. Molecular Biology, Pollard
8. Fundamental Molecular Biology, L. A. Allison, Blackwell Publisher
9. Molecular Biology of the gene, J. D. Watson, Benjamin Publishing house

Biochemistry:

1. Biochemistry and Molecular Biology, Elliot, W. H. and D. C. Elliot, Oxford University Press
2. Text Book of Biochemistry with clinical correlation, Devlin T. M., Wiley-Liss, New
3. Lehninger's Principles of Biochemistry, Nelson D.L. and M. M. Cox, Worth Publishers, New York
4. Biochemistry, Stryer L., W. H. Freeman and Company, New York
5. Biochemistry, Voet and Voet, John Wiley and Sons Inc.
6. Biochemistry : Berg, J.M.; Tymoczko, J. L.; Stryer, L.; W. H. Freeman, New York

DZOOCCT0202N : Taxonomy and Biostatistics L.H.=68 ; Credit: 02 ; FM= 50

Taxonomy

1. Recent Trends in Taxonomy: Cytotaxonomy, Chemotaxonomy, Molecular Taxonomy; Basics of Barcoding, Applications of DNA Barcode, Constraints of DNA Taxonomy; Parataxonomy.

2. Phenetic and Cladistic Schools: Numerical Taxonomy: Analysis, Methodology; Construction of Phenogram and Cladogram; Polarity decision; Parsimony; Out group comparison; Phylogenetic groups: Monophyly, Paraphyly, Polyphyly; Determination of Genetic Distance.

3. Phylogenetic Trees: Understanding Phylogenetic Trees; Kinds of Phylogenetic Trees.

4. Dimensions of speciation and taxonomic characters:

    a. Mechanism of speciation in panmictic and apomictic species.
    b. Species concept – species category, different species concepts, sub-species and other infra-specific categories.
    c. Theories of biological classification, hierarchy of categories.
    d. Taxonomic characters – different kinds, origin of reproductive isolation - biological mechanisms of genetic incompatibility.

Biostatistics

1. Measures of central tendency and dispersal.

2. Probability distribution (Binomial, Poisson and Normal).

3. Different between parametric and non-parametric statistics; confidence level and errors levels of significance.

4. Regression and Correlation.

5. t-test, X^2 – test, Analysis of Variance.

SUGGESTED BOOKS:

Taxonomy:

1. Principles of Systemic Zoology : E. Mayr & Ashlock – McGraw Hill Pub.
2. Elements of taxonomy : E. Mayer
3. Animal Taxonomy : Kapoor Oxford and IBH Pub. Co.2000
4. Molecular Systematics : Li and Graur – Sinaeur Associates, Sunderland.
5. Genomes : Brown – Blackwell Science.
6. Evolutionary Biology : D. Futuyama - Sinaeur Associates, Sunderland.
7. Evolution : Volpe & Rossenbaum – McGraw Hill Pub.
8. Taxonomy : Quicke

Biostatistics:

1. Biostatistical Analysis : N. G. Das
2. Biostatistics : Zar
3. Biostatistics : P. Bhattacharyya
4. Biostatistics : N. Shetty
5. Biostatistics : V. B. Rastogi

DZOOCCT0203N : Parasitology and Immunology L.H.=68 ; Credit: 02 ; FM= 50

Parasitology

1. Terminologies related to animal associations.
2. Parasitic transmission – types and mechanism.
3. Origin and evolution of parasitism.
4. Cellular, molecular and physiological aspects of host – parasite interactions.

Immunology

1. Phylogeny and ontogeny of immune system:
    a. Innate and Acquired immunity.
    b. Cell-mediated and Humoral immunity.
    c. Location and structures of lymphoid organs.
    d. Cells of immune system and their function.
2. Nature of antigens:
    a. Antigenicity and immunogenicity.
    b. Factors influencing immunogenicity.
    c. Haptens and adjuvants.
    d. Epitopes and superantigens.
3. Structures and functions of antibodies:
    a. Classes and sub-classes.
    b. Gross and fine structures.
    c. Antibody mediated effector functions.
4. MHC in mouse and HLA inhuman:
    a. MHC haplotypes.
    b. Class I and Class II molecules.
    c. Cellular distribution.
    d. Peptide binding.
    e. Expression and diversity.
    f. Disease susceptibility and MHC /HLA.
5. Cytokines
6. Vaccines

SUGGESTED BOOKS:

Parasitology:

1. Foundation of Parasitology : Janovy and Roberts
2. Animal Parasitology : Smyth
3. Clinical Parasitology : Beaver
4. Parasitology : Cheng
5. Parasitic Protozoa : Krier and Baker
6. Helminths, Arthropods and Protozoa of Domesticated Animals : Soulsby

Immunology:

1. Essentials of Immunology : I. M. Roitt
2. Immunology : J. Kuby
3. Advances in : Parasitology : Baker et.al.
4. Immunology : Abbas
5. Immunology : Rao
6. Immunology : N. Shetty
7. Immunology : Weir & Stewart
8. Immunology : A.K. Chakravarty – Oxford University Press.
9. Schaum series Immunology

CORE COURSE (PRACTICAL)

DZOOCCP0204N : Cell Biology and Biochemistry L.H.=102 ; Credit: 02 ; FM= 50

1. Collection and preparation of pedigrees and their analysis.
2. Preparation of sex chromatin.
3. Identification of mutant varieties of *Drosophila* sp.
4. Colorimetric / Spectrophotometric estimation of Glucose; Proteins; DNA and their standard curve preparation.
5. Estimation of sugars by Somogyi-Nelson Method.

DZOOCCP0205N : Taxonomy, Biostatistics and Parasitology

L.H.=102 ; Credit: 02 ; FM= 50

1. Preparation of key of invertebrate specimens (as available at the market or from laboratory specimens) upto subclasses /order.
2. Preparation of key of vertebrate specimens (as available at the market or from laboratory specimens) upto subclasses / order.
3. Preparation of data in relation to mean, standard deviation (SD) and standard error (SE).
4. Calculation of correlation among height, weight and age.
5. Calculation of normal and binomial distribution.
6. Collection and identification of common gut parasites of Insect /Amphibian/ Mammals.

DZOOCCP0206N : Scientific Excursion Credit: 02 ; FM= 50

DSE (THEORY)

DZOODET0201A : Taxonomy and Anatomy of Insects

DZOODET0201B : Taxonomy and Physiology of Fishes

DZOODET0201C : Environmental Protection and Sustainability

DZOODET0201D : Intracellular Protein Trafficking and Cancer Biology

DZOODET0201E : Medical Protozoology

DZOODET0201F : NCC

DZOODET0201G : NSS

DZOODET0201H : MOOCS

DZOODET0201A : Taxonomy and Anatomy of Insects L.H.=68 ; Credit: 02 ; FM= 50

1. Classification of insects; major Orders with features and examples.
2. External morphology---
   a. Integuments- Epidermis, cuticle, molting.
   b. Head, thorax and abdomen.
   c. Pre and post genital appendages.
3. Anatomy---
   a. Nervous and sensory system.
   i. Eyes and vision-- occurrence and structure of compound eyes, light reception, function.
   b. Blood and circulatory system.
      i. Structure- heart, types of haemocytes, structure, function.
   j. Excretory system.
      i. Excretion- Definition and types.
      ii. Special types of excretory organs/ conditions.
   d. Reproductive system.
      i. Male and female reproductive organs.
   e. Endocrine system.
      i. Endocrine organs.
      ii. Pheromones, semi-chemicals and defensive secretions.

SUGGESTED BOOKS:

1. Chapman R.F. 2000. The Insect : Structure and Function, 4thEnd. Cambridge Low price End. Cambridge Univ. Press.
2. Dey, S. and Raziuddin, M. : The female reproductive system of aak grasshopper : A histomorphological study. Lambert Academic Publishing.
3. Gullan, P.J. and P.S Cranstor : The Insect: An outline of Entomology, Chapman & Hall.
4. Saxena, S.C : Biology of Insects, Oxford and IBH Publishing Co. Pvt.Ltd.
5. Srivastava, K.P. : A test Book of Applied Entomology Vol. I &II, Kalyani Publishers.
6. Tembhre, D. B. : Modern Entomology.

DZOODET0201B : Taxonomy and Physiology of Fishes L.H.=68 ; Credit: 02 ; FM= 50

1. Classification of fishes upto Order.
2. Biology of some common fishes---
   a. Rohu
   b. Catla
   c. Mrigal
   d. Magur
   e. Murrel
   f. Maekeral
   g. Bombay duck
3. Exotic fishes--- Silver carp, Grass carp, Common carp.
4. Respiration in fishes--- Holobranch, Hemibranch, Accessory respiratory organ.
5. Endocrine organs--- Pituitary, Thyroid, Adrenal, Ultimobranchial gland, Corpuscles of stannous.
6. Diseases of fish.

SUGGESTED BOOKS:

1. Air breathing fishes of India : J. S. Dutta Munshi and G. M. Hughes
2. Aquaculture : T. V. R. Pillai
3. Biology of fishes : Bone and Moore
4. Fish and fisheries : S. Kumar and M. Tembhre
5. Fish and fisheries : S. S. Khanna
6. Fish and fisheries of India : V. G. Jhingran
7. Fisheries in India : R. Mitra

DZOODET0201C : Environmental Protection and Sustainability

L.H.=68 ; Credit: 02 ; FM= 50

1. Evolution of Environmental Protection.
2. Global Environment Picture.
3. Meeting human needs while protecting the environment.
   a. Understanding sustainable development.
   b. The three pillars for sustainable development.
   c. Principle of sustainable development.
4. Strategies towards sustainability.
5. Understanding environmental crisis- religious, cultural, biological, evolutionary, psychological and economic reasons.
6. Sustainable ethics.
7. Sustainability and Economic development.
8. Law, Government and Society role towards sustainability.

SUGGESTED BOOKS:

1. Fundamentals of Ecology : Odum
2. Ecology : Krebs
3. Ecology : Riclefs and Miller
4. Fundamentals of Ecology : Dash
5. Environmental Science : Wright
6. Ecology : Begon Harper
7. Ecological theories and applications : Peter Stiling

DZOODET0201D : Intracellular Protein Trafficking and Cancer Biology

L.H.=68 ; Credit: 02 ; FM= 50

1. Translocation of secretory protein across the ER membrane. Insertion of proteins into the ER membrane.
2. Protein modification, folding and quality control in ER. Vesicular traffic, secretion and endocytosis.
3. Introduction, Biochemistry and Molecular Biology of cancer. Oncogenes and tumor suppressor genes: Role in cancer development.
4. Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer, and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis.
5. Chemical carcinogenesis and Angiogenesis.
6. Therapy: Therapeutic interventions of uncontrolled cell growth.

SUGGESTED BOOKS:

1. Molecular Cell Biology : J. Darnell et.al.
2. Molecular Biology of the Cell : Alberts et.al.
3. Cell Biology : Cooper
4. Cell and Molecular Biology : De Robertis and De Robertis
5. Molecular Cell Biology, Lodish et.al., Scientific American Book Inc. USA.
6. Cell and Molecular Biology, G. Karp, John Wiley and Sons
7. Molecular Biology, Pollard
8. Fundamental Molecular Biology, L. A. Allison, Blackwell Publisher

DZOODET0201E : Medical Protozoology L.H.=68 ; Credit: 02 ; FM= 50

1. Classification of parasitic protozoa with medical importance.
2. Study of the ultrastructure and Life cycle pattern, of *Entamoeba histolytica***,** *Giardia* sp., *Trichomonas* sp., *Leishmania* sp., *Trypanosoma* sp., *Plasmodium* sp., *Balantidium coli, Naegleria fowleri, Acanthamoeba* sp.
3. Epidemiology of protozoan diseases: general epidemiology, methods of epidemiological study.
4. Host's immunity against parasitic protozoa.
5. Immune evasion strategies of parasitic protozoa.
6. Chemotherapeutic targets in parasitic protozoan: properties of an effective drug, classes of drugs, mechanism of action of drugs and drug resistance.

SUGGESTED BOOKS:

1. Foundation of Parasitology : Janovy and Roberts
2. Animal Parasitology : Smyth
3. Parasitology : Cheng
4. Parasitic Protozoa : Krier and Baker
5. Parasitism : The Diversity and Ecology of Animal Parasites : Bush and Fernandez
6. Illustrated guide to Protozoa : Leedale, Bradbury, Lee and Soldo
7. Biology of Parasitism : Tschudi and Pearce
8. Protocols in Protozoology : Lee and Soldo

DZOODET0201F : NCC Credit: 02 ; FM= 50

DZOODET0201G : NSS Credit: 02 ; FM= 50

DZOODET0201H : MOOCS Credit: 02 ; FM= 50

SEC

To be selected from NBU basket.

THIRD SEMESTER:

CORE COURSE (THEORY)

DZOOCCT0301N : Biotechnology and Biophysical Technique

L.H.=68 ; Credit: 02 ; FM= 50

Biotechnology

1. Recombinant DNA technology: restriction endonucleases, strategies and applications.
2. Cell culture methods and applications.
    a. Design and functioning of tissue culture laboratories.
    b. Cell proliferation measurements.
    c. Cell viability testing.
    d. Culture media preparation and cell harvesting methods.
3. Tools and techniques applied in biotechnology.
4. Basic applications and tools in bioinformatics.
5. Gene and Somatic cloning techniques.
    a. Transgenic technology; production, prospects, advantages and disadvantages.
    b. Animals as bioreactors.
    c. Knockout model systems & their utility.

Biophysical technique

1. Microscopy: Principles of light transmission, phase – contrast, fluorescence, confocal, SEM, TEM.
2. Principles and Uses: Spectrophotometer and Spectrofluorometer.
3. Cryotechnologies:
    a. Cryopreservation for cells, tissue, organisms.
    b. Cryotechniques for microscopy.
4. Separation techniques:
    a. Centrifugation: Principles of Sedimentation, Differential and Density gradient centrifugation.
    b. Electrophoresis: Principles, PAGE (SDS and NATIVE), Agarose gel electrophoresis, 2-D gel electrophoresis.
    c. Chromatography: Principles, Column chromatography, GLC, HPLC, Ion-exchange chromatography, Gel exclusion chromatography, Affinity chromatography.

SUGGESTED BOOKS:

Biotechnology:

1. Molecular Cloning : A laboratory manual: Sambrook and Russell. Vol. I, II, III, Cold Spring Harbour Laboratory Press, New York.
2. Concepts in Biotechnology : Balasubramanium
3. Text book of biotechnology : R. C. Dubey
4. Biotechnoogy : P. K.Gupta
5. Animal Cell Culture - a practical approach : R. W. John(Ed.)
6. Introduction to Instrumental analysis : R. Braun
7. A Biologists Guide to Principles and Techniques of Practical Biochemistry : K. Wilson and K. H. Goulding
8. Biotechnology : H. D. Kumar

Biophysical Technique:

1. Practical Biochemistry : Wilson and Wilmer
2. Biochemical Calculations : Sigel
3. Biochemistry and Molecular Biology : Elliot, W. H. and D. C. Elliot, Oxford University Press
4. Text Book of Biochemistry with clinical correlation, Devlin T. M., Wiley-Liss, New
5. Lehninger's Principles of Biochemistry : Nelson D.L. and M. M. Cox, Worth Publishers, New York
6. Biochemistry : Stryer L., W. H. Freeman and Company, NewYork
7. Biochemistry : Voet and Voet
8. Biophysical techniques : Frifelder

CORE COURSE (PRACTICAL)

DZOOCCP0302N : Biophysical and Histochemistry Techniques

L.H.=102 ; Credit: 02 ; FM= 50

1. Handling of different types of microscopes.
2. Paper/ TLC Chromatographic technique.
3. Gel Electrophoresis technique.
4. Cytochemical staining – PAS, Feulgen, Sudan – staining of lipid Mercury bromophenol test of proteins.
5. Histological staining and identification of tissues.
6. Microtechniques.

DSE (THEORY)

DZOODET0301A : Physiology of Insects

DZOODET0301B : Environmental Entomology

DZOODET0301C : Pest and Vector Biology

DZOODET0301D : Fish Behaviour and Reproduction

DZOODET0301E : Fisheries Management

DZOODET0301F : Practices and Economy of Fisheries

DZOODET0301G : Ecosystem: The Basic Unit of Natural World

DZOODET0301H : Environmental Resources: Issues, Management and Solution for Sustainability

DZOODET0301I : Environmental Pollution and Prevention

DZOODET0301J : Quantitative and Human Genetics

DZOODET0301K : Genome Analysis and Mapping Strategies

DZOODET0301L : Protein-nucleic acid interaction and Genetic engineering

DZOODET0301M : Helminthology

DZOODET0301N : Applied Immunology

DZOODET0301O : Parasitology

DZOODET0301A : Physiology of Insects L.H.=68 ; Credit: 02 ; FM= 50

1. Hormones- secretion, mode of action, chemical nature and functions.
2. Metamorphosis and hormonal control.
3. Feeding and digestion.
4. Mechanism of circulation.
5. Image formation and Sound production.
6. Locomotion--- terrestrial, aquatic, aerial.
7. Reproduction and Morphogenesis--- gametogenesis, seminal transfer, fertilization, sex determination, embryogenesis, post-embryonic morphogenesis.
8. Behaviour--- kinds, periodicity, control of behavior, communication, biological functions of behaviour.

DZOODET0301B : Environmental Entomology L.H.=68 ; Credit: 02 ; FM= 50

1. Life forms of high altitude insects.
2. Insect and environment:
    a. Insect population and the abiotic and biotic environment.
    b. Insect adaptations to forest ecology.
    c. Insect and their environment
        i. Plant structural complexity and Host of age plant.
        ii. Plant nutrition and Herbivory.
        iii. Mutualism and Coevolution.
        iv. Insect in Forests as an example of Community.
3. Forest pests and their management.
4. Insect diversity and conservation.

DZOODET0301C : Pest and Vector Biology L.H.=68 ; Credit: 02 ; FM= 50

1. Insect and agriculture
    a. Insects as pest, Assessment of pest status, EIL, ETL, etc.
    b. Important pest of Paddy, Jute, Sugarcane, Tea, Stored grain pest--- their distribution, nature of damage, biology and control measures.
    c. Insect control--- chemical control nature; mode of action of common pesticides--- organochlorine, organophosphorus, carbamates, etc.
    d. Biological, cultural, toxicity of pheromones and other attractants.
    e. Biotechnology in insect control, IPM.
2. Insects and Acarines in public health importance
    a. Insect vectors and its importance in transmission of parasites; their control.
    b. Biology and medical importance of---
        i. Mosquitoes

ii. Sand flies
iii. Tsetse flies
iv. Bugs
v. Hard ticks and soft ticks
vi. Trombicuted and allergic mites
vii. Pediculus

SUGGESTED BOOKS:

1. Chapman R.F. 2000. The Insect : Structure and Function, 4thEnd. Cambridge Low price End. Cambridge Univ. Press.
2. Chatterjee, P. B. : Plant protection Technique, Bharati Bhawan. (P &D).
3. Dey, S. and Raziuddin, M. : The female reproductive system of aak grasshopper : A histomorphological study. Lambert Academic Publishing.
4. Gullan, P.J. and P.S Cranstor : The Insect: An outline of Entomology, Chapman & Hall.
5. Krebs, C.J. : Ecology, the Experimental analysis of Distribution and Abundance, Harper & Row Publishers.
6. Pedigo, L,P. : Entomology and Pest management, Prentice: Hall of India Pvt.Ltd.
7. Saxena, S.C : Biology of Insects, Oxford and IBH Publishing Co. Pvt.Ltd.
8. Srivastava, K.P. : A test Book of Applied Entomology Vol. I &II, Kalyani Publishers.
9. Tembhre, D. B. : Modern Entomology.
10. Yazdani, S.S, and M.L Agarwal : Element of Insect Ecology, Narosa Publishing House.

DZOODET0301D : Fish Behaviour and Reproduction L.H.=68 ; Credit: 02 ; FM= 50

1. Migratory behaviour in fishes.
2. Parental care in fishes.
3. Marine, freshwater, estuarine, reservoir and cold-water fishes in India.
4. Hill stream fishes and Deep sea fishes.
5. Origin of paired fins.
6. Weberian ossicle and swim bladder.
7. Reproduction and development of bony fishes.

DZOODET0301E : Fisheries Management L.H.=68 ; Credit: 02 ; FM= 50

1. Fishery- definition, scope, fishery resources in India.
2. Finfish culture.
3. Monoculture and polyculture practices.
4. Role of exotic fishes in polyculture.
5. Induced breeding, knowledge of fish seed transport.
6. Prawn culture- Giant freshwater prawn and tiger prawn, sources, seed, culture methods, problems.
7. Pearl culture- Pearl producing species and their distribution, pearl culture method, formation and composition of pearl.

DZOODET0301F : Practices and Economy of Fisheries L.H.=68 ; Credit: 02 ; FM= 50

1. Exploring aquaculture--- definition, scope, types of fisheries, modern techniques in fishery management.
2. Cultivable water, water quality, physical and chemical properties of water.
3. Fish culture--- monoculture, polyculture, composite fish culture, carp cultivation in India.
4. Fishing gears, Fish preservation, processing, transport and marketing (in India).
5. Induced breeding, hybridization, maintenance of fishing ponds and hatcheries.
6. Paddy field culture.
7. Fish by-product.

SUGGESTED BOOKS:

1. Advances in fish biology : H. R. Singh
2. Air breathing fishes of India : J. S. Dutta Munshi and G. M. Hughes
3. Aquaculture : T. V. R. Pillai
4. Biology of fishes : Bone and Moore
5. Ecology of aquatic system : M. Dobson and C. Frid
6. Fish and fisheries : S. Kumar and M. Tembhre
7. Fish and fisheries : S. S. Khanna
8. Fish and fisheries of India : V. G. Jhingran
9. Fish and fisheries products : FAO
10. Fisheries bioeconomics : FAO
11. Fisheries in India : R. Mitra

DZOODET0301G : Ecosystem: The Basic Unit of Natural World

L.H.=68 ; Credit: 02 ; FM= 50

1. Structure and Function of Ecosystem.
2. Ecosystem to global biomes.
   a. Role of climate.
   b. Microclimate and other climatic factors.
   c. Biotic factors.
   d. Physical barriers.
3. Energy flow in ecosystem.
4. Biogeochemical cycles- Carbon, Nitrogen, Phosphorus.
5. Dynamics of natural population.
6. Mechanism of population equilibrium.
7. Human impact on ecosystem.

DZOODET0301H : Environmental Resources: Issues, Management and Solution for Sustainability **L.H.=68 ; Credit: 02 ; FM= 50**

1. Food production and distribution.
   a. Major patterns of food production.
   b. Food distribution and trade.
   c. Hunger, malnutrition and famine.
   d. Barriers to a sustainable agricultural system.
2. Preserving biological diversity.
   a. Values of wild species.
   b. Biodiversity and its decline.
   c. Protecting biodiversity.
3. Water resources.
   a. Hydrological cycle, natural cycle and human impact.
   b. Water resources and its management.
4. Non-renewable energy- Fossil fuel, Natural gas, Coal, Oil.
5. Renewable energy- Solar energy, Wind energy, Geothermal energy, Hydropower, biogas, Tidal energy, Energy from waste, Hydrogen and Nuclear energy.
6. Foundation of sustainable energy system.

DZOODET0301I : Environmental Pollution and Prevention

L.H.=68 ; Credit: 02 ; FM= 50

1. Types of environmental hazards
   a. Air, water, solid waste, noise and radioactive pollution.
   b. Heavy metals and their toxicity.

c. Endocrine disruptors.
d. Bioaccumulation and biomagnification.
e. Xenobiotic biotransformation: Phase I and Phase II.
f. Absorption, translocation and excretion.
g. Dose response curve.

2. Environmental biotechnology
   a. Bioremediation
   b. Biosensors
3. Environmental biomonitoring
   a. EIA
   b. ERA

SUGGESTED BOOKS:

1. Fundamentals of Ecology : Odum
2. Ecology : Krebs
3. Ecology : Riclefs and Miller
4. Fundamentals of Ecology : Dash
5. Environmental Science : Wright
6. Ecology : Begon Harper
7. Ecological theories and applications : Peter Stiling

DZOODET0301J : Quantitative and Human Genetics

L.H.=68 ; Credit: 02 ; FM= 50

1. Polygenic inheritance, heritability and its measurements, QTL mapping.
2. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function.
3. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation.
4. Human genetics:
   a. Pedigree analysis, lod score for linkage testing.
   b. Human Genome Project.
5. Stem cell biology: strategies and application.
6. Genetic Counselling.

DZOODET0301K : Genome Analysis and Mapping Strategies

L.H.=68 ; Credit: 02 ; FM= 50

1. Gene function analysis: Random mutagenesis, site specified mutagenesis, targeted mutagenesis, Imprinting of genes and molecular mechanism of gene silencing.
2. Somatic cell genetics:
   a. Cell fusion and Hybrids.
   b. Heterokaryon – selecting hybrids, radiation hybrids, hybrid panels.
3. DNA damage and repair mechanisms, homologous and site-specific recombination.
4. C- value paradox, detailed account of various models of prokaryotic genomes, viral and prokaryotic genomes.
5. Recombination: Homologous and non-homologous recombination including transposition.
6. Genetic and Physical Mapping: Strategies for different levels of genome mapping.

DZOODET0301L : Protein-nucleic acid interaction and Genetic engineering

L.H.=68 ; Credit: 02 ; FM= 50

1. Conformation of protein and nucleic acids: Topology, hybridization and renaturation kinetics.
2. Stability of proteins and nucleic acids. Interaction between proteins and nucleic acid.
3. Protein sequencing methods, detection of post-translation modification of proteins.
4. DNA sequencing methods, strategies for genome sequencing.

5. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Isolation of specific nucleic acid sequences.
6. Generation of genomic and cDNA libraries in a plasmid, phage, cosmid, BAC and YAC vectors. *In vitro* mutagenesis and deletion techniques, gene knocks out in bacterial and eukaryotic organisms.
7. Methods for analysis of gene expression at RNA and protein level, large scale expressions, such as microarray-based techniques isolation, separation and analysis of carbohydrate and lipid molecules. RFLP, RAPD and AFLP techniques.

SUGGESTED BOOKS:

1. Molecular Cell Biology : J. Darnell et.al.
2. Molecular Biology of the Cell : Alberts et.al.
3. Cell Biology : Cooper
4. Cell and Molecular Biology : De Robertis and De Robertis
5. Molecular Cell Biology, Lodish et.al., Scientific American Book Inc. USA.
6. Cell and Molecular Biology, G. Karp, John Wiley and Sons
7. Molecular Biology, Pollard
8. Fundamental Molecular Biology, L. A. Allison, Blackwell Publisher
9. Molecular Biology of the gene, J. D. Watson, Benjamin Publishing house
10. Old and Primrose : Principle of Gene Manipulation.
11. From Gene To Clones : Winnacker
12. Alberts et.al.
13. Lodish et.al.
14. Watson et.al. Pearson education
15. Genetic Engineering : Watson et.al.
16. Lewin – Genes Series : Pearson education
17. Becker, The world of the cell, Pearson education
18. Gardner et.al., Principle of Genetics, John Wiley and Sons
19. Snustad and Simmons, Principle of Genetics, John Wiley and Sons
20. Klug and Cummings, Concepts of Genetics, Pearson education
21. Pierce B.A., Genetics : A conceptual approach, W.H. Freeman and Company, New York.
22. Hartwell et.al. : Genetics from genes to genomes

DZOODET0301M : Helminthology L.H.=68 ; Credit: 02 ; FM= 50

1. Classification of parasitic helminthes.
2. Study of the general morphology and Life cycle pattern of *Fasciola* sp., *Schistosoma* sp., *Clonorchis* sp., *Taenia* sp., *Echinococcus* sp., *Ascaris* sp., *Wuchereria* sp., *Onchocerca* sp., *Trichinella* sp., *Ancylostoma* sp., *Drucunculus* sp., *Enterobious* sp.
3. Epidemiology of helminthic diseases: general epidemiology, methods of epidemiological study.
4. Host-parasite interaction in helminth parasites (*Fasciola* sp., *Schistosoma* sp., *Clonorchis* sp., *Taenia* sp., *Echinococcus* sp., *Ascaris* sp., *Wuchereria* sp., *Onchocerca* sp., *Trichinella* sp., *Ancylostoma* sp., *Drucunculus* sp., *Enterobious* sp.)
5. Chemotherapeutic targets in parasitic helminthes: properties of an effective drug, classes of drugs, mechanism of action of drugs and drug resistance.
6. Nematodes in plant pathology.

DZOODET0301N : Applied Immunology L.H.=68 ; Credit: 02 ; FM= 50

1. Hypersensitivity
   a. Type I
   b. Type II
   c. Type III
   d. Type IV
2. Tolerance and Autoimmunity
   a. General features and mechanisms of immunologic tolerance.
   b. Regulation of immunity and tolerance by dendritic cells.
   c. Malfunction and different autoimmune disease.
3. Tumor Immunology
   a. Strategies of tumor cell to evade Immune system.
   b. Anti-tumor Immune response.
   c. Modern Immunotherapy of Cancer.
4. Transplantation Immunology
   a. Basis of Transplantation.
   b. Acute, Hyperacute and Chronic graft rejection.
   c. Modern techniques of transplantation (e.g. BMT, liver, cornea, etc.)
5. Immunodeficiencies
   a. Congenital Immunodeficiencies.
   b. Acquired Immunodeficiencies.
6. Immunoprophylaxis
   a. Principles and Significance.
   b. Types of Vaccines (subunit, killed, attenuated, etc.)

DZOODET0301O : Parasitology **L.H.=68 ; Credit: 02 ; FM= 50**

1. Host's immunity against virus, bacteria, protozoa and helminth.
2. Immune evasion strategies of virus, bacteria, protozoa and helminth.
3. Fish and poultry parasites and its impact on human society.
4. Vaccine targets.
5. Metabolic strategies in parasites.
6. Antigen antibody reaction and its role in clinical parasitology; common diagnostic methods.
7. Biology of arthropods as parasites and vectors (Flies, Ticks, Mites, Lice, Bugs, Fleas).
8. Myasis and its evolutionary pathway.
9. Zoonotic potentiality of parasitic diseases.

SUGGESTED BOOKS:

1. Foundation of Parasitology : Janovy and Roberts
2. Animal Parasitology : Smyth
3. Clinical Parasitology : Beaver
4. Parasitology : Cheng
5. Parasitic Protozoa : Krier and Baker
6. Helminths, Arthropods and Protozoa of Domesticated Animals : Soulsby
7. Essentials of Immunology : I. M. Roitt
8. Immunology : J. Kuby
9. Advances in : Parasitology : Baker et.al.
10. Immunology : Abbas
11. Immunology : Rao
12. Immunology : N. Shetty
13. Immunology : Weir & Stewart
14. Immunology : A.K. Chakravarty – Oxford University Press.
15. Schaum series Immunology
16. Parasitism : The Diversity and Ecology of Animal Parasites : Bush and Fernandez
17. Veterinary Parasitology – Reference Manual : William J. Foreyt
18. Practical Exercises in Parasitology : Halton, Behnke and Marshall
19. Illustrated guide to Protozoa : Leedale, Bradbury, Lee and Soldo
20. Biology of Parasitism : Tschudi and Pearce
21. Protocols in Protozoology : Lee and Soldo
22. The Biology of Nematodes : Donald L. Lee

GE

DZOOGET0301A : Wildlife Biology

DZOOGET0301B : Ethology

DZOOGET0301A : Wildlife Biology L.H.=102 ; Credit: 04 ; FM= 100

1. Definition of wildlife, importance of wildlife and rationale for their conservation.
2. Classification of wildlife according to severity of threats: CITES, WWF, BLI, IUCN, BNHS, IOBP, WLII.
3. *In situ* and *ex situ* conservation: prospects and limitations.
4. Socio-economic perspective of wildlife conservation.
5. Wild life Habitat
   a. Characteristic, Fauna and Adaptation with special reference to Tropical forest.
   b. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and buffers, nodes and corridors.
   c. Community Reserves and Conservation Reserves.
6. Wildlife in India
   a. Wildlife wealth of India & threatened wildlife.
   b. Reasons for wildlife depletion in India.
   c. Wildlife conservation approaches and limitations.
7. Wildlife management in India, principles and strategies of conservation.
   a. Special Management Programme of Wild Animals in India: Project tiger, Project rhino, Project elephant, Project crocodile.
   b. Distribution, status, habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle.
8. **Continuing Evaluation**

SUGGESTED BOOKS:

Wildlife biology:

1. Wildlife ecology. Aaron, N.M. (1973) : W.H. Freeman Co. San Francisco, USA
2. Faunal diversity in India, ZSI : J.R.S. Alfred, A.K. Das and A. K Sanyal, Calcutta
3. The book of Indian Reptiles and Amphibians, J.C. Daneil Oxford publications
4. Biodiversity and its conservation in India : S.S. Negi, Indus Publishing Co., New Delhi
5. The Book of Indian Animals : S.H. Prater, BNHS/Oxford
6. Indian wildlife resources: Ecology and development. B.D. Sharma, Daya Publishing House, Delhi

DZOOGET0301B : Ethology **L.H.=102 ; Credit: 04 ; FM= 100**

1. Innate and learnt behaviour.
   a. Neural and hormonal control of behaviour.
   b. Genetic and environmental components in development of behaviour.
2. Ecological aspects of behaviour:
   a. Habitat selection, food selection, optimal foraging theory, anti – predator defence.
   b. Aggression, homing, territoriality, dispersal.
   c. Communication: Chemical, Visual, Light, Audio.
3. Group selection:
   a. kin selection.
   b. Altruism.
   c. reciprocal altruism.
   d. inclusive fitness.
4. Cooperation and conflict:
   a. Male-male competition and sexual selection.
   b. Elaborate ornaments: Fisher's hypothesis and Handicap hypothesis.
   c. Parent-offspring conflict.
   d. Range of cooperative behaviours and Prisoner's dilemma.
5. Reproductive behaviour:
   a. Evolution of sex and reproductive strategies.
   b. Mating systems.
   c. Courtship.
   d. Parental care.
6. **Continuing Evaluation**

SUGGESTED BOOKS:

Ethology:

1. Animal Behaviour : Manning & Dawkins
2. Animal Behaviour : Drickamer et.al.
3. Animal Behaviour : An Evolutionary Approach : Alcock
4. Principles of Animal Behaviour :
5. Perspectives of Animal Behaviour : Goodenough et.al.
6. Animal Behaviour : Ridley
7. Behavioural Ecology : An Evolutionary Approach : Krebs &Davies
8. An Introduction to Behavioural ecology : Krebs and Davies
9. Cooperation and conflicts in animal Societies : Gadagkar
10. Threats to Indian mammals : G.K. Saha & S. Majumder

AEC

To be selected from NBU basket.

FOURTH SEMESTER:

CORE COURSE (THEORY)

DZOOCCT0401N : Inheritance Biology and Evolutionary Genetics

L.H.=68 ; Credit: 02 ; FM= 50

Inheritance Biology

1. Concept of gene: allele, multiple alleles, pseudoallele, complementation tests.
2. Sex determination and dosages compensation in *Drosophila* and Humans.
3. Human Karyotype, banding and nomenclature.
4. Extra-chromosomal inheritance: Inheritance of mitochondrial and maternal inheritance.
5. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Evolutionary Genetics

1. Concept of: Population, gene pool, gene frequency, genotype frequency, Hardy – Weinberg law.
2. Destabilising forces influencing allelic frequency; mutation, natural selection, migration and genetic drift.
3. Genetic structure of population: Optimum phenotype, Selection pressure, Fisher's Theorem of natural selection, Genetic Homeostasis, Canalization, Genetic Load and Mutational Load.
4. Molecular evolution and phylogenetics:
    a. Gene evolution.
    b. Nucleic acid phylogeny – DNA – DNA hybridization, nucleotide sequence comparison and homologies.
    c. Molecular clocks.
    d. Molecular drive.
5. Origin of higher categories:
    a. Micro and macroevolution.
    b. Phyletic gradualism and punctuated equilibria.
    c. Concept of co-evolution.
    d. Heterochrony.

SUGGESTED BOOKS:

Genetics:

1. Old and Primrose : Principle of Gene Manipulation.
2. From Gene To Clones : Winnacker
3. Alberts et.al.
4. Lodish et.al.
5. Watson et.al. Pearson education
6. Genetic Engineering : Watson et.al.
7. Brooker : Genetics
8. Strickberger : Genetics
9. Suzuki et.al. : Genetics
10. Lewin – Genes Series : Pearson education
11. Allison
12. Becker, The world of the cell, Pearson education
13. Gardner et.al., Principle of Genetics, John Wiley and Sons
14. Snustad and Simmons, Principle of Genetics, John Wiley and Sons
15. Klug and Cummings, Concepts of Genetics, Pearson education
16. Pierce B.A., Genetics : A conceptual approach, W.H. Freeman and Company, New York.
17. Hartwell et.al. : Genetics from genes to genomes

Population Genetics:

1. Population Genetics: A Concise Guide : John H.Gillespie
2. Principles of population genetics : Daniel L. Hartl
3. Population genetics and microevolutionary theory : Alan Templeton
4. An introduction to population genetics theory : James F. Crow
5. Genetics of populations : Philip W. Hedrick
6. Elements of human genetics : Luigi Luca Cavalli-Sforza
7. Human population genetics : John H. Relethford
8. Introduction to Population Genetics : Richard Halliburton
9. Introduction to Theoretical Population Genetics : Thomas Nagylaki
10. Theoretical Population Genetics : J. S.Gale

Evolution:

1. Evolutionary Biology : D. J. Futuyama - Sinaeur Associates, Sunderland
2. Genes and Evolution : Jha – McMillan India Ltd.
3. Evolution : Ridley – Blackwell Science
4. Evolution and Genetics : Merrel
5. Evolutionary Genetics : M. Smyth – Blackwell Science
6. Evolution : Strickberger
7. Molecular Evolution : Li and Graur - Sinaeur Associates, Sunderland
8. Life : Adaptation, Evolution and Ethology : S. Chattopadhyay. Books and Allied

DZOOCCT0402N : Environmental Physiology and Neurobiology

L.H.=68 ; Credit: 02 ; FM= 50

Environmental Physiology

1. Introduction:
    a. Basic concepts of Environmental stress and strain.
    b. Concept of Homeostasis.
    c. Mechanisms of cell volume regulation.
    d. Nature, levels and mechanisms of adaptation.
2. Temperature and its effects:
    a. Heat transfer between animal and the environment.
    b. Terminology and strategies in thermal biology.
    c. Thermal biology of---
        i. Homeotherms
        ii. Ectotherms
        iii. Endotherms
        iv. Heterotherms
    d. Thermoregulation and specialized metabolic states.
    e. Evolution and advantages of varying thermal strategies.
3. Homeostasis and physiological integration of animal in different environmental habitat:
    a. Aquatic (freshwater and marine)
    b. Terrestrial
    c. Parasitic animals
4. Biochemical adaptations to extreme living conditions as in:
    a. High altitude animals
    b. Deep diving animals
    c. Freeze tolerant animals

Neurobiology

1. Central Nervous System – Structure and functions (in human).
2. Nerve impulse generation and propagation, membrane transport and signaling through neurolemma.
3. Overview of synaptic function:
    a. Ionotropic and metabotropic receptors and neurotransmission.
    b. Mechanism of neurotransmitter release.
    c. Role of calcium in biochemistry of exocytosis and endocytosis.
4. Neuromuscular junction:
    a. Organization and properties of neuromuscular junction.

b. Neurotransmitters, neurohormones and neuromodulators.

5. Aspects of neuronal disorders.

    a. Strokes
    b. Epilepsy
    c. Parkinson's disease
    d. Alzheimer's disease

SUGGESTED BOOKS:

Environmental Physiology:

1. Animal Physiology : Mechanisms and Adaptation : R. Eckert
2. Biochemical Adaptation : P. W. Hochachka and G. N. Somero
3. General and Comparative Animal Physiology : W. S. Hoar
4. Animal Physiology: Adaptation and Environment : Schmidt-Nielsen
5. Physiology: A Regulatory System Approach : F. L. Strand
6. Environmental and Metabolic Animal Physiology : C. L. Prosser
7. Environmental Physiology : P. G. Stone Willmer and L. Johnston
8. Adaptation to Environment : R. C. Newell
9. Physiological Ecology : An Evolutionary Approach to Resource Use: C. R. Townsend and P. Callow
10. Optima for Animals : R. M. N. Alexander
11. Physiological Animal Ecology : G. N. Louw

Neurobiology:

1. Medical Physiology : Guyton
2. Human Physiology : Rhodes and Pflang
3. Human Physiology : S.I. Fox
4. Molecular Cell Biology, Lodish et.al., Scientific American Book Inc. USA
5. Molecular Biology of the Cell : Alberts et.al.
6. Neuroscience : Purves
7. Foundations of Neurobiology : Fred Delcomyn

DZOOCCP0403N : Project/ Dissertation/ Review L.H.=102 ; Credit: 02 ; FM= 50

DZOOCCP0404N : Seminar Presentation (based on Project/Dissertation/Review)

L.H.=34 ; Credit: 01 ; FM= 25

DZOOCCP0405N : Comprehensive Viva Credit: 01 ; FM= 25

DSE (PRACTICAL)

DZOODEP0401A : Entomology Practical

DZOODEP0401B : Fisheries Practical

DZOODEP0401C : Environmental Biology Practical

DZOODEP0401D : Cytogenetics Practical

DZOODEP0401E : Parasitology Practical

DZOODEP0401A : Entomology Practical L.H.=102 ; Credit: 02 ; FM= 50

1. Mounting--- wings, mouth parts, antennae, genitalia of commonly found and medically important insects.
2. Preparation of keys upto Order level.
3. Identification with reasons--- common Orders.
4. Study of insect control measuring techniques and associated instruments.
5. Study of life cycle of a pest/vector.
6. Submission of insect of different order (insect box).
7. Field trip and insect diversity study.

DZOODEP0401B : Fisheries Practical L.H.=102 ; Credit: 02 ; FM= 50

1. Major dissection: Dissection of important representative of any teleost fish (as specimen available at the market) --- general anatomy.
2. Minor dissection: Mounting of girdles, ossicle, types of scales, caudal fin (as specimen available at the market), counting of fin rays.
3. Spot identification:
    a. Common freshwater fishes
    b. Common marine fishes
4. Identification with reasons of museum specimens.
5. Fishing gears.
6. Key preparation upto Order level.

DZOODEP0401C : Environmental Biology Practical L.H.=102 ; Credit: 02 ; FM= 50

1. Analysis of soil and water:
    a. Free CO_2, dissolved O_2, hardness, alkalinity and salinity.
    b. Organic carbon in soil.
2. Microbiology:

a. Isolation of bacteria from soil / water.
b. Gram staining of bacteria.

3. Evaluation of LC_{50} and probit analysis.
4. Determination of primary productivity by light and dark bottle method.
5. Evaluation of: Diversity index of communities – terrestrial and aquatic.
6. Evaluation of toxicant on tissues – histochemical and biochemical changes.
7. SDS-PAGE.

DZOODEP0401D : Cytogenetics Practical L.H.=102 ; Credit: 02 ; FM= 50

1. Chromosome karyotyping.
2. DNA isolation.
3. Blotting Techniques.
4. Separation of protein fragments by SDS-PAGE.
5. Mitotic and meiotic chromosome preparation.
6. Polytene chromosome preparation.

DZOODEP0401E : Parasitology Practical L.H.=102 ; Credit: 02 ; FM= 50

1. Post-mortem examination of invertebrates and vertebrates for protozoans, helminth and arthropod parasites. Preparation of gut and blood smear and smear from other body region. Fixation, preservation, staining and mounting of parasites.
2. Staining methods: i) gut parasite staining methods-Delafield haematoxylin method, Trichome staining ii) Blood smear staining methods: Giemsa staining, Leishman staining.
3. Histological studies of the digestive and reproductive system of any parasitic flatworm (cestode/trematode).
4. Taxonomic identification (upto species level): *Plasmodium sp.*, *Trypanosoma sp.*, *Entamoeba histolytica*, *Giardia sp.*, *Coccidia*, *Wuchereria bancrofti*, and microfilaria, *Ancylostoma duodenale*, *Echinococcus granulosus*, *Schistosoma mansoni/haematobium*, *Simulium*, *Cimex*, *Pediculushumanus.*
5. Common test of antigen-antibody reaction: Blood grouping, ELISA test.

GE

DZOOGET0401A : Conservation Biology

DZOOGET0401B : Elementary Human Physiology

DZOOGET0401A : Conservation Biology L.H.=102 ; Credit: 04 ; FM= 100

1. History and distinctions of conservation biology.
2. Legal foundations of conservation biology:
    a. NEPA, CITES, Convention on Biological Diversity, Kyoto protocol, Nagoya Protocol, Ramsar Convention on conservation of wetlands.
    b. Forest Conservation Act of India (1927), Wildlife Conservation Act of India (1972), Environment Protection Act of India (1986), Indian Biodiversity law and rules.
3. Red data book and conservation status and threats of Indian wildlife.
4. Use of Bioresources and Conservation Ethics:
    c. Diverse uses of bioresources; history of exploitation and causes of overexploitation of bioresources; importance of conservation.
    d. Social awareness and social movements concerning conservation issues.
5. Use of Remote Sensing and GIS:
    a. Principles and practical applications of remote sensing techniques, including aerial photography and satellite imagery.
    b. GIS Applications in wildlife. Use and values of GIS approaches to wildlife ecology and management integrating wildlife into forest and human land use systems.
6. **Continuing Evaluation**

SUGGESTED BOOKS:

Conservation Biology:

1. Caughley, G., and A. Gunn. : Conservation Biology in Theory and Practice, Blackwell Science, Cambridge, Massachusetts, USA
2. Cox, G. W. : Conservation Biology : Concepts and Applications, McGraw-Hill, Dubuque, Iowa, USA
3. Dasmann, Raymond Fredric: Wildlife Biology, 2nd ed. John Wiley & Sons
4. NY. Dobson, A. P. : Conservation and Biodiversity, Scientific American Library, New York, USA
5. Hunter Jr., M. L. : Fundamentals of Conservation Biology, Blackwell Science, Malden, Massachusetts, USA
6. Jeffries, M. J. : Biodiversity and Conservation. Routledge, New York, USA
7. Leveque, C., and J.-C. Mounolou.: Biodiversity. John Wiley and Sons, West Sussex, England
8. Lyndermayer D.B. & J.F. Franklin : Conserving forest biodiversity: a comprehensive multiscaled approach, Island Press
9. Conservation Biology : Foundations Concepts and Applications, Fred Van Dyke, Springer
10. Remote Sensing and GIS for Site Characterization : Applications and Standards By Vernon Singhroy, D. Nebert, Arnold Ivan Johnson Published by ASTM International
11. Environmental Modelling with GIS and Remote Sensing : Andrew K. Skidmore, Hendrik Prins, published by CRC Press
12. GIS and Remote Sensing in Hydrology, Water Resources and Environment : Yangbo Chen, International Association of Hydrological Sciences, published by IAHS

DZOOGET0401B : Elementary Human Physiology L.H.=102 ; Credit: 04 ; FM= 100

1. **Blood and circulation** - Formed elements of blood- origin, function and fate; hemoglobin; blood volume; blood groups; hemostasis; lymph and tissue fluids- circulation, function and fate; lymphatic organs.
2. **Cardiovascular System:** Anatomy of heart; specialized tissues of heart; origin and propagation of heart impulse; cardiac cycle; cardiac output; blood pressure; ECG- its principle and significance.
3. **Respiratory system** - Anatomy of lung and airways; mechanism of breathing; lung volumes and capacities; exchange of gases; neural and chemical regulation of respiration.
4. **Nervous and muscle system:** Neuron, resting membrane potential, action potential; synapse; neuromuscular junction; gross anatomy of brain and spinal cord; reflex action; central and peripheral nervous system; ultrastructure of skeletal, smooth and cardiac muscles; mechanism of skeletal muscle contraction.
5. **Digestive system** - Anatomy of alimentary canal; digestive glands- location and secretion; composition and function of salivary, gastric, pancreatic, intestinal juices and bile; digestion and absorption; BMR.
6. **Excretory system** - Anatomy of kidney; nephron; urine formation; constituents of urine; micturition; renal regulation of water balance, acid-base balance, blood volume and blood pressure.
7. **Reproductive biology:** Primary and accessory sex organs and secondary sex characters; histology of testis and ovary; spermatogenesis, oogenesis and ovulation; menstrual cycle; puberty; pregnancy and placenta; parturition and lactation.
8. **Practical**

a. Red blood cell count (i) Method (ii) Calculation (iii) Hemocytometer.
b. Total White blood cell count [T.L.C.] (i) Method (ii) Calculation.
c. Differential White blood cell count [D.L.C.] (i) Normal value and Morphology of white cells (ii) Counting method (iii) Staining procedures.
d. Coagulation Tests (i) Bleeding time (Duke's method) (ii) Clotting time (Capillary glass tube method).
e. Estimation of Hemoglobin by Sahli's method.
f. Determination of ABO and Rh Blood Group System by Slide method.

or **Continuing Evaluation**

SUGGESTED BOOKS:

Elementary Human Physiology:

1. Text Book of Medical Physiology, A.C. Guyton. W.B. Saunders Co.
2. Best & Taylor's Physiological Basis of Medical Practice, O.P. Tandon & Y. Tripathi, Lippincott Williams & Wilkins
3. Review of Medical Physiology, W.F. Ganong. Lange Medical Book. Prentice-Hall International
4. Human Physiology: An Integrated Approach, D.U. Silverthorn, Pearson
5. Medical Physiology, A.B. Mahapatra, Current Books International
6. Essentials of Medical Physiology, K. Sembulingam & P. Sembulingam, Jaypee Brothers Medical Publishers Pvt. Ltd.
7. Human Physiology Vol. 1 & 2, C.C. Chatterjee, Medical Allied Agency
8. Concise Medical Physiology, S.K. Chaudhuri, New Central Book Agency
9. Wintrobe's Clinical Haematology, J.P. Greer et.al., Wolters Kluwers
10. William's Hematology, E. Deutler et.al., McGrawhill

SEC

To be selected from NBU basket.