

Raja N. L. Khan Women's College (Autonomous)

Curriculum for B.Sc. Honours in Zoology

[Choice Based Credit System]

Semester-I

Sl. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C1	C1T: Non- Chordates-I	Core Course-1		4	0	0	6	75
	C1P: Non- Chordates-I (Practical)	Core Course1 [Practical]		0	0	4		
C2	C2T: Ecology	Core Course-2		4	0	0	6	75
	C2P:Ecology (Practical)	Core Course-2 [Practical]		0	0	4		
GE-1	GE-1	GE					4/5	75
	GE-1	GE (Practical)					2/1	
AECC	English	AECC					2	50
				Total Credits =20				

L=Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: English /Modern Indian Language.

Interdisciplinary/Generic Elective (GE) from other Department

[Four papers are to be taken and each paper will be of 6 credits]: [Papers are to be taken from any of the following discipline (GE-1 Preferably Chemistry/Physiology)]:Chemistry/Botany/Physiology/ComputerSc./Microbiology/Bio Technology/ Geology /Nutrition /Aquaculture Management.

Semester -1

Core Course-1

CC-1: Non-Chordates I

Credits 06

C1T1: Non-Chordates I

Credit 04

C1P1: Non-Chordates I

Credit 02

C1T1: Non-Chordates I	4 Credits	Class
Unit 1: Basics of Animal Classification		4
Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types		
Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Six kingdom concept of classification (Card woese)		
Unit 2: Protista and Metazoa		15
General characteristics and Classification up to phylum (according to Levine et. al., 1981) Locomotion in <i>Euglena</i> , <i>Paramecium</i> and <i>Amoeba</i> ; Conjugation in <i>Paramecium</i> .		
Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i>		
Evolution of symmetry and segmentation of Metazoa		
Unit 3: Porifera		6
General characteristics and Classification up to classes; Canal system and spicules in sponges		
Unit 4: Cnidaria		10
General characteristics and Classification up to classes Metagenesis in <i>Obelia</i> & <i>Aurelia</i>		
Metagenesis in <i>Obelia</i>		
Polymorphism in Cnidaria		
Corals and coral reef diversity, function & conservation		
Unit 5: Ctenophora		2
General characteristics		

Unit 6: Platyhelminthes		6
General characteristics and Classification up to classes		
Life cycle and pathogenicity and control measures of <i>Fasciola hepatica</i> and <i>Taenia solium</i>		
Unit 7: Nematoda		7
General characteristics and Classification up to classes		
Life cycle, and pathogenicity and control measures of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i>		
Parasitic adaptations in helminthes		

REFERENCE BOOKS:

- **Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International**
- **Invertebrates by Brusca & Brusca. Second edition, 2002.**
- **Classification for metazoans to be followed from: Rupert and Barnes, 1994, 6th Edition**

C1 P1 –Non-Chordates I Lab

Credits 02

List of Practical

1. Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*
2. Identification of *Amoeba*, *Euglena*, *Entamoeba*, *Opalina*, *Paramecium*, *Plasmodium vivax* and *Plasmodium falciparum* (from the prepared slides)
3. Identification of *Sycon*, Neptune's Cup, *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora*
4. Identification and significance of adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides*
5. Staining/mounting of any protozoa/helminth from gut of cockroach

Core Course-2

CC-2: Ecology

Credits 06

C2T: Ecology

Credit 04

C2P: Ecology

Credit 02

C2T2: Ecology	4 Credits	Class
Unit 1: Introduction to Ecology		4
History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.		
Unit 2: Population		20
Unitary and Modular populations		
Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion.		
Geometric, 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.		
Unit 3: Community		11
Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession with one example.		
Unit 4: Ecosystem		10
Types of ecosystems with an 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 an example of Nitrogen cycle		
Human modified ecosystem		
Unit 5: Applied Ecology		5
Wildlife Conservation (in-situ and ex-situ conservation).		

Management strategies for tiger conservation; Wild life protection act (1972)		
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REFERENCE BOOKS:

- 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
- Ecology: Theories & Application (2001). 4th Edition
by Peter Stilling.
- Ecology by Cain, Bowman & Hacker. 3rd edition.
Sinauer associates

C1 P1 –Non-Chordates I Lab

Credits 02

List of Practical

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

Note: In field report costal area to be included.

Generic Elective Syllabus

GE-1 [Interdisciplinary for other department]

GE-1: Animal Cell Biotechnology

Credits 06

GE-1T: Animal Cell Biotechnology

Credit 04

GE-1P: Animal Cell Biotechnology

Credit 02

GE-1T: Animal Cell Biotechnology	4 Credits	Class
Unit 1: Introduction		2
Concept and Scope of Biotechnology		
Unit 2: Techniques in Gene manipulation		15
Recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes		
Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, and HAC. Shuttle and Expression Vectors.		
Construction of Genomic libraries and cDNA libraries		
Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.		
Unit 3: Animal cell Culture		9
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures.		
Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays.		
Unit 4: Fermentation		8
Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized.		

Downstream Processing: Filtration, centrifugation, extraction, chromatography, spraydrying and lyophilization.		
Unit 5: Transgenic Animal Technology		6
Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.		
Unit 6: Application in Health		6
Development of recombinant Vaccines, Hybridoma technology, Gene Therapy. Production of recombinant Proteins: Insulin and growth hormones.		
Unit 7: Bio safety Physical and Biological containment		4
Bio safety Physical and Biological containment		

REFERENCE BOOKS:

- Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
- Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
- P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
- B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
- T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science(2001).
- Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998).
- Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York
- Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart
- W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA

List of Practical

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from E. coli/animals/ human.
4. Plasmid DNA isolation (p UC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
6. Preparation of competent cells and Transformation of E. coli with plasmid DNA using CaCl₂, Selection of transformants on X-gal and IPTG (Optional).
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays

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Semester-II

Sl. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C3	C3T: Non- Chordates-II	Core Course-3		4	0	0	6	75
	C3P: Non- Chordates-I (Practical)	Core Course3 [Practical]		0	0	4		
C4	C4T: Ecology	Core Course-4		4	0	0	6	75
	C4P:Ecology (Practical)	Core Course-4 [Practical]		0	0	4		
GE-2	GE-2	GE					4/5	75
	GE-2	GE (Practical)					2/1	
AECC-2	Environmental Studies	AECC						

L=Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: English /Modern Indian Language.

Interdisciplinary/Generic Elective (GE) from other Department

[Four papers are to be taken and each paper will be of 6 credits]: [Papers are to be taken from any of the following discipline (GE-1 Preferably Chemistry/Physiology)]: Chemistry/Botany/Physiology/ComputerSc./Microbiology/ /Nutrition .

Semester –II

Core Courses

Core-3

CC-3: Non-Chordates II

Credits 06

C3T: Non-Chordates II

Credit 04

C3P: Non-Chordates II

Credit 02

C3T: Non-Chordates II	4 Credits	Class
Unit 1: Introduction Evolution of coelom and metamerism		2
Unit 2: Annelida General characteristics and Classification up to classes. Excretion in Annelida through nephridia. Metamerism in Annelida.		10
Unit 3: Arthropoda General characteristics and Classification up to classes Vision in Insecta only. Respiration in Arthropoda (Gills in prawn and trachea in cockroach) Metamorphosis in Lepidopteran Insects Social life in termite		16
Unit 4: Onychophora General characteristics and Evolutionary significance		2
Unit 5: Mollusca General characteristics and Classification up to classes Nervous system and torsion in Gastropoda Feeding and respiration in <i>Pila</i> sp		10
Unit 6: Echinodermata General characteristics and Classification up to classes Water-vascular system in Asteroidea Larval forms in Echinodermata Affinities with Chordates		8
Unit 7: Hemichordata General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates		2

Note: Classification to be followed from Rupert and Barnes, 1994, 6th Edition.

List of Practical

1. Study of following specimens:
 - a. Annelids- *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*
 - b. Arthropods - *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta*, termites and honey bees *Onychophora - Peripatus*
 - c. Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus*
 - d. Echinodermates - *Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria*
and
 - e. *Antedon*
2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
4. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta*
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Core-4

CC-4: Cell Biology

Credits 06

C4T: Cell Biology

Credit 04

C4P: Cell Biology

Credit 02

4 Credits	Class
Unit 1: Overview of Cells	2
Basic structure of Prokaryotic and Eukaryotic cells, Viruses, Viroid, Prion and Mycoplasma	
Unit 2: Plasma Membrane	6
Ultra structure and composition of Plasma membrane: Fluid mosaic model	
Transport across membrane: Active and Passive transport, Facilitated transport	
Cell junctions: Tight junctions, Gap junctions, Desmosomes	
Unit 3: Cytoplasmic organelles I	5
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	
Protein sorting and mechanisms of vesicular transport	
Unit 4: Cytoplasmic organelles II	6
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis	
Peroxisomes: Structure and Functions	
Centrosome: Structure and Functions	
Unit 5: Cytoskeleton	5
Type, structure and functions of cytoskeleton	
Accessory proteins of microfilament & microtubule	
A brief idea about molecular motors	
Unit 6: Nucleus	8
Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus	
Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)	
Unit 7: Cell Division	10
Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes with specialreference to p53, Retinoblastoma and Ras and APC. Mitosis and Meiosis: Basic process and their significance	
Unit 8: Cell Signaling	8

Cell signalling transduction pathways; Types of signaling molecules and receptors GPCR and Role of second messenger (cAMP) Extracellular matrix-Cell interactions Apoptosis and Necrosis	
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C4P–Cell Biology (Lab)

Credits 02

List of Practical

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female bloodcells/cheek cells.
4. Preparation of permanent slide to demonstrate:
 - a. DNA by Feulgen reaction
 - b. Cell viability study by Trypan Blue staining
 - c. Mitochondria identification through vital staining

Generic Elective Syllabus

GE-2 [Interdisciplinary for other department]

GE-2: Aquatic Biology

Credits 06

GE2 T: Aquatic Biology

Credits 04

GE2 P: Aquatic Biology

Credits 02

GE2 T- Aquatic Biology

Unit 1: Aquatic Biomes

Brief introduction to the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

Unit 2: Freshwater Biology

Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico- chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen, Sulphur and Phosphorous).

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill- stream fishes.

Unit 3: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

Unit 4: Management of Aquatic Resources

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD

GE3 P: Aquatic Biology Lab

Credits 02

List of Practical

1. Determine the area of a lake using graphimetric and gravimetric method.

2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance

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[Choice Based Credit System]

Semester-III

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC-5		C5T: Chordates	Core Course - 5	4	0	0	6	75
		C5P: Chordates Lab		0	0	4		
CC-6		C6T: Animal Physiology: Controlling & Coordinating Systems	Core Course - 6	4	0	0	6	75
		C6P: Animal Physiology: Controlling & Coordinating Systems Lab		0	0	4		
CC-7		C7T: Fundamentals of Biochemistry	Core Course - 7	4	0	0	6	75
		C7P: Fundamentals of Biochemistry Lab		0	0	4		
GE-3	TBD		Generic Elective -3				4/5	75
							2/1	
SEC-1		SEC-1: Apiculture Or SEC-1: Aquarium Fish Keeping	Skill Enhancement Course-1	1	1	0	2	50
Semester Total							26	350

L=Lecture, T= Tutorial, P=Practical, CC = Core Course, GE= Generic Elective, SEC = Skill Enhancement Course, TBD = to be decided

Generic Elective (GE) (Interdisciplinary) from other Department [Four papers are to be taken and each paper will be of 6 credits]: Papers are to be taken from any of the following discipline: Chemistry/Botany/Physiology/Computer Sc./Microbiology /Nutrition /Aquaculture Management.

Semester-III

Course Course (CC)

CC-5: Chordates

Credits 06

CC-5 T: Chordates

Credits 04

CC-5 P: Chordates

Credits 02

Unit 1: Introduction to Chordates

General characteristics and outline classification of Phylum Chordata

Unit 2: Protochordata

General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Retrogressive metamorphosis in *Ascidia*. Chordate Features and Feeding in *Branchiostoma*

Unit 3: Origin of Chordata

Dipleurula concept and the Echinoderm theory of origin of chordates
Advanced features of vertebrates over Protochordata

Unit 4: Agnatha

General characteristics and classification of cyclostomes up to order

Unit 5: Pisces

General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses

Accessory respiratory organ, migration and parental care in fishes
Swim bladder in fishes.

Classification up to Sub-Classes

Unit 6: Amphibia

General characteristics and classification up to living Orders.
Metamorphosis and parental care in Amphibia

Unit 7: Reptilia

General characteristics and classification up to living Orders.
Poison apparatus and Biting mechanism in Snake

Unit 8: Aves

General characteristics and classification up to Sub-Classes
Exoskeleton and migration in Birds
Principles and aerodynamics of flight

Unit 9: Mammals

General characters and classification up to living orders
Affinities of Prototheria
Exoskeleton derivatives of mammals
Adaptive radiation in mammals with reference to locomotory appendages
Echolocation in Micro chiropterans and Cetaceans

Unit 10: Zoogeography

Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms

CC-5 P: Chordates

Credits 02

List of Practical

1. Protochordata
Balanoglossus, Herdmania, Branchiostoma
2. Agnatha
Petromyzon, Myxine
3. Fishes
Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas, Flat fish
4. Amphibia
Necturus, Bufo, Hyla, Alytes, Axolotl, Tylotriton
5. Reptilia
Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus. Key for Identification of poisonous and non-poisonous snakes
6. Mammalia: Bat (Insectivorous and Frugivorous), *Funambulus*
7. Pecten from Fowl head
8. Dissection of brain and pituitary of Tilapia

CC-6: Credit-06

Animal Physiology: Controlling & Coordinating Systems

CC-6 T: Animal Physiology

Credits 04

CC-6 P: Animal Physiology

Credits 02

Unit 1: Tissues

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue and, fixation and staining of tissues.

Unit 2: Bone and Cartilage

Structure and types of bones and cartilages, Ossification

Unit 3: Nervous System

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types

Unit 4: Muscular system

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre

Unit 5: Reproductive System

Histology of testis and ovary Physiology of Reproduction

Unit 6: Endocrine System

Histology and function of pituitary, thyroid, pancreas and adrenal
Classification of hormones; Mechanism of Hormone action
Signal transduction pathways for Steroidal and Non steroidal hormones
Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system
Placental hormones

Suggested Readings:

1. Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.
2. Eckert Animal Physiology by David Randall and Warren Burggren. 4th edition. W. H. Freeman.

List of Practical

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as kneejerk reflex)
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
4. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues

CC7- Fundamentals of Biochemistry

CC-7 T: Fundamentals of Biochemistry

Credits 04

CC-7 P: Fundamentals of Biochemistry

Credits 02

Unit 1: Carbohydrates

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosaccharides

Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

Unit 2: Lipids

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpenoids.

Lipid metabolism: β -oxidation of fatty acids; Fatty acid biosynthesis

Unit 3: Proteins

Amino acids

Structure, Classification, General and Electro chemical properties of α -amino acids; Physiological importance of essential and non-essential amino acids

Proteins

Bonds stabilizing protein structure; Levels of organization

Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Unit 4: Nucleic Acids

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids

Types of DNA and RNA, Complementarity of DNA, Hypo-

Hyperchromaticity of DNA Basic concept of nucleotide metabolism

Unit 5: Enzymes

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot;

Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each)

Unit 5: Oxidative Phosphorylation

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and uncouplers of Electron Transport System

CC-7 P: Fundamentals of Biochemistry

Credits 02

List of Practical

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Quantitative estimation of Lowry Methods.
4. Demonstration of proteins separation by SDS-PAGE.
5. To study the enzymatic activity of Trypsin and Lipase.
6. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.

Skill Enhancement Course (SEC)

SEC1: Apiculture

Credits 02

SEC1T: Apiculture

Unit 1: Biology of Bees

History, Classification and Biology of Honey Bees Social Organization of Bee Colony

Unit 2: Rearing of Bees

Artificial Bee rearing (Apiary),
Beehive Newton and
Langstroth Bee Pasturage
Selection of Bee Species for
Apiculture Bee Keeping
Equipment Methods of
Extraction of Honey
(Indigenous and Modern)

Unit 3: Diseases and Enemies

Bee Diseases and Enemies Control and Preventive measures

Unit 4: Bee Economy

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen
etc

Unit 5: Entrepreneurship in Apiculture

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial
Beehives for cross pollination in horticultural gardens

Generic Elective Syllabus

[Interdisciplinary for other department]

GE3 T – Animal Diversity

Unit 1 : Protista M.Mw

Protozoa : General Characters of Protozoa ; Life cycle of *Plasmodium*

Unit 2 : Porifera M.Uw

General characters and canal system in Porifera

Unit 3 : Radiata MS

General characters of Cnidarians and Polymorphism of *Obelia*

Unit 4 : Acclomates MS

General characters of Helminthes

Unit 5 : Pseudocoelomates MMw

General characters of Nematoda, Parasitic adaptations

Unit 6 : Annelida MMw

General characters of Annelida, Metamerism

Unit 7 : Arthropoda MMw

General characters, Social life in insects (termites)

Unit 8 : Mollusca MS

General characters of Mollusca, Torsion in Gastropods

Unit 9 : Echinodermata MS

General characters of Echinodermata. Water vascular system in Starfish.

Unit 10 : Protochordata MS

Salient features

Unit 11 : Pisces MMw

General Charaters, Osmoregulation

Unit 12 : Amphibia MS

General characters, Parental care

Unit 13 : Reptilia *MMw*

General characters, Poison apparatus and biting mechanism of Poisonous snake.

Unit 14 : Aves *MS*

General Characters, Flight adaptations

Unit 15 : Mammalia *MS*

General Characters

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Semester-IV

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hourper week			Credit	Marks
				L	T	P		
CC-8		C8T: Comparative Anatomy of Vertebrates	Core Course - 8	4	0	0	6	75
		C8P: Practical		0	0	4		
CC-9		C9T: Animal Physiology: Life Sustaining Systems	Core Course - 9	4	0	0	6	75
		C9P: Practical		0	0	4		
CC-10		C10T: Immunology	Core Course - 10	4	0	0	6	75
		C10P: Practical		0	0	4		
GE-4	TBD		Generic Elective -4				4/5	75
							2/1	
SEC-2		SEC2: Sericulture	Skill Enhancement Course-2	1	1	0	2	50
Semester Total							26	350

L=Lecture, **T**= Tutorial, **P**=Practical, **CC** = Core Course, **GE**= Generic Elective, **SEC** = SkillEnhancement Course, **TBD** = to be decided

Generic Elective (GE) (Interdisciplinary) from other Department [Four papers are to betaken and each paper will be of 6 credits]: Papers are to be taken from any of the following discipline: Chemistry/Botany/Physiology/Computer Sc./Microbiology /**Nutrition**.

Semester-IV
Core Course (CC)

CC-8: Comparative Anatomy of Vertebrates **Credits 06**

C8T: Comparative Anatomy of Vertebrates **Credits 04**

Unit 1: Integumentary System

Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System

Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.

Unit 3: Digestive System

Comparative anatomy of stomach; dentition in mammals

Unit 4: Respiratory System

Respiratory organs in fish, amphibian, birds and mammals

Unit 5: Circulatory System

General plan of circulation, Comparative account of heart and aortic arches

Unit 6: Urinogenital System

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System

Comparative account of brain, Cranial nerves in mammals

Unit 8: Sense Organs

Classification of receptors, Brief account of olfactory and auditory receptors in vertebrate

C8P: Comparative Anatomy of Vertebrates **Credits 02**

List of Practical

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig.
3. Demonstration of Carapace and plastron of turtle.
4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal.
5. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system.

CC-9: Animal Physiology: Life Sustaining Systems

Credits 06

C9T: Animal Physiology: Life Sustaining Systems

Credits 04

Unit 1: Physiology of Digestion

Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; Digestive enzymes

Unit 2: Physiology of Respiration

Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning

Unit 3: Physiology of Circulation

Components of Blood and their functions; Structure and functions of haemoglobin Haemostasis; Blood clotting system, Fibrinolytic system Haemopoiesis; Basic steps and its regulation Blood groups; ABO and Rh factor

Unit 4: Physiology of Heart

Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses Cardiac Cycle and cardiac output Blood pressure and its regulation

Unit 5: Thermoregulation & Osmoregulation

Physiological classification based on thermal biology.

Thermal biology of endotherms

Osmoregulation in aquatic vertebrates

Extrarenal osmoregulatory organs in vertebrates

Unit 6: Renal Physiology

Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

C9P: Animal Physiology: Life Sustaining Systems Lab Credits 02

List of Practical

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer

CC-10: Immunology

Credits 06

C10T: Immunology

Credits 04

Unit 1: Overview of Immune System

Basic concepts of health and diseases, Historical perspective of Immunology, Cells and organs of the Immune system

Unit 2: Innate and Adaptive Immunity

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).

Unit 3: Antigens

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

Unit 4: Immunoglobulins

Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production

Unit 5: Major Histocompatibility Complex

Structure and functions of MHC molecules.

Structure of T cell Receptor and its signalling, T cell development & selection

Unit 6: Cytokines

Types, properties and functions of cytokines.

Unit 7: Complement System

Components and pathways of complement activation.

Unit 8: Hypersensitivity

Gell and Coombs' classification and brief description of various types of hypersensitivities.

Unit 9: Immunology of diseases

Malaria, Filariasis, Dengue and Tuberculosis

Unit 10: Vaccines

Various types of vaccines. Active & passive immunization (Artificial and natural).

C10P: Immunology Lab Credits 02

List of Practical

1. Demonstration of lymphoid organs.

2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Demonstration of ELISA

Skill Enhancement Courses (SEC)

SEC-2: Sericulture

Credits 02

SEC2T: Sericulture

Unit 1: Introduction

Sericulture: Definition, history and present status; Silk route

Types of silkworms, Distribution and Races

Exotic and indigenous races

Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

Life cycle of *Bombyx mori*

Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

Selection of mulberry variety and establishment of mulberry garden

Rearing house and rearing appliances.

Disinfectants: Formalin, bleaching powder, RKO

Silkworm rearing technology: Early age and Late age rearing

Types of mountages

Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates

Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture Visit to various sericulture centres.

Generic Elective Syllabus
GE-4 [Interdisciplinary for other department]

GE-4: Environment and Public Health

Credits 06

GE4T: Environment and Public Health

Credits 04

Unit 1: Introduction

Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment.

Unit 2: Climate Change

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit 3: Pollution

Air, water, noise pollution sources and effects, Pollution control.

Unit 4: Waste Management Technologies

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants.

Unit 5: Diseases

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis.

GE4P: Environment and Public Health Lab Credits 02

List of Practical

To determine pH, Cl, SO₄, NO₃ in soil and water samples from different locations.

Raja N. L. Khan Women's College (Autonomous)

Curriculum for B.Sc. Honours in Zoology

[Choice Based Credit System]

Semester-V

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hourper week			Credit	Marks
				L	T	P		
CC- 11		C11T: Molecular Biology	Core Course - 11	4	0	0	6	75
		C11P: Practical		0	0	4		
CC- 12		C12T: Genetics	Core Course - 12	4	0	0	6	75
		C12 P: Practical		0	0	4		
DSE- 1		TBD	Discipline Specific Elective - 1	4	0	0	6	75
				0	0	4		
DSE-2		TBD	Discipline Specific Elective - 2	4	0	0	6	75
Semester Total							24	300

L= Lecture, T= Tutorial, P = Practical, CC - Core Course, **TBD** - To be decided, **DSE**: Discipline Specific Elective.

Semester-V
Core Courses (CC)

CC-11: Molecular Biology

Credits 06

C11T: Molecular Biology

Credits 04

Course Contents:

Unit 1: Nucleic Acids

Salient features of DNA and RNA. Watson and Crick Model of DNA

Unit 2: DNA Replication

Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 3: Transcription

Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

Unit 4: Translation

Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA

Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Unit 6: Gene Regulation

Regulation of Transcription in prokaryotes: *lac* operon and *trp* operon;

Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 7: DNA Repair Mechanisms

Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 8: Molecular Techniques

PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing

C11P: Molecular Biology (Lab)

Credits 02

List of Practical

1. Demonstration of polytene and lampbrush chromosome from photograph
2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement)
3. Agarose gel electrophoresis for DNA

CC-12: Genetics
C12T: Genetics

Credits 06
Credits 04

Unit 1: Mendelian Genetics and its Extension

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

Unit 2: Linkage, Crossing Over and Chromosomal Mapping

Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence

Unit 3: Mutations

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination

Mechanisms of sex determination in *Drosophila*

Sex determination in mammals

Dosage compensation in *Drosophila* & Human

Unit 5: Extra-chromosomal Inheritance

Criteria for extra chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Kappa particle in *Paramecium* Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements

Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, LINE, SINE, Alu elements in human

C12P: Genetics (Lab)

Credits 02

List of Practical

1. Chi-square analyses
2. Linkage maps based on conjugation
3. Identification of chromosomal aberration in *Drosophila* and man from photograph
4. Pedigree analysis of some human inherited traits

Discipline Specific Electives (DSE)

DSE-1 : Animal Behaviour and Chronobiology
DSE1T : Animal Behaviour and Chronobiology

Credits 06
Credits 04

Unit 1: Introduction to Animal Behaviour

Origin and history of Ethology, Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen Proximate and ultimate causes of behaviour, Methods and recording of a behaviour

Unit 2: Patterns of Behaviour

Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour

Social Behaviour: Concept of Society; Communication and the senses

Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.

Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology

Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period.

Adaptive significance of biological clocks

Unit 5: Biological Rhythm

Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin.

DSE1P: Animal Behaviour and Chronobiology (Lab)

Credits 02

List of Practical

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

DSE-2: Animal Biotechnology
DSE2T: Animal Biotechnology

Credits 06
Credits 04

Unit 1: Introduction

Organization of prokaryotic and eukaryotic genome, Concept of genomics

Unit 2: Molecular Techniques in Gene manipulation

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

Southern, Northern and Western blotting

DNA sequencing: Sanger method

Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3: Genetically Modified Organisms

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice

Unit 4: Culture Techniques and Applications

Animal cell culture, expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)

DSE2P: Animal Biotechnology (Lab)

Credits 02

List of Practical

1. Genomic DNA isolation from E. coli
2. Plasmid DNA isolation (pUC 18/19) from E. coli
3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs a. Southern Blotting
 - b. Northern Blotting
 - c. Western Blotting
 - d. DNA Sequencing (Sanger's Method)
 - e. PCR
 - f. DNA fingerprinting
7. Project report on animal cell culture

Raja N. L. Khan Women's College (Autonomous)

Curriculum for B.Sc. Honours in Zoology

[Choice Based Credit System]

Semester-VI

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hourper week			Credit	Marks
				L	T	P		
CC- 13		C13T: Developmental Biology	Core Course - 11	4	0	0	6	75
		C13P: Practical		0	0	4		
CC- 14		C14T: Evolutionary Biology	Core Course - 12	4	0	0	6	75
		C14 P: Practical		0	0	4		
DSE- 3		TBD	Discipline Specific Elective - 3	4	0	0	6	75
				0	0	4		
DSE-4		TBD	Discipline Specific Elective - 4	4	0	0	6	75
Semester Total							24	300

L= Lecture, T= Tutorial, P = Practical, CC - Core Course, TBD - To be decided, DSE:
Discipline Specific Elective.

CC-13: Developmental Biology
C13T: Developmental Biology

Credits 06
Credits 04

Unit 1: Introduction

Basic concepts: Phases of Development, Cell cell interaction, Differentiation and growth, Differential gene expression.

Unit 2: Early Embryonic Development

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers.

Unit 3: Late Embryonic Development

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Unit 4: Post Embryonic Development

Development of brain and Eye in Vertebrate. Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).

Unit 5: Implications of Developmental Biology 8 Class

Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis.

Suggested Readings:

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Publishers, Sunderland, Massachusetts, USA
2. Slack JMW , Essential Developmental Biology Inc.,

C13P: Developmental Biology Lab Credits 02

List of Practical

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages).
2. Study of the developmental stages and life cycle of Drosophila from stock culture.
3. Study of different sections of placenta (photomicrograph/ slides).
4. Project report on Drosophila culture/chick embryo development.

CC-14: Evolutionary Biology
C14T: Evolutionary Biology

Credits 06
Credits 04

Evolutionary Biology

Unit-1: Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, evolution of eukaryotes.

Unit-2: Historical review of Evolutionary concepts, Lamarkism, Darwinism and Neo Darwinism.

Unit-3: Geological time scale, Fossil records of Hominids (from *Australopithacus* to *Homo sapiens*), evolution of horse. Neutral theory of molecular evolution, Molecular clock.

Unit-4: Sources of variations: Heritable variations and their role in evolution.

Unit-5: Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application Of law to biallelic Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).Genetic Drift mechanism (founder's effect, bottleneck phenomenon). Role of Migration and Mutation in changing allele frequencies.

Unit-6: Species concept, Isolating mechanisms, modes of speciation. Adaptive radiation /macroevolution (exemplified by Galapagos finches).

Unit-7: Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction.

Unit-8: Origin and Evolution of Man, Unique Hominin characteristics contrasted with primate characteristic Molecular analysis of human origin.

Unit-9: Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, Convergent & Divergent evolution.

Suggested Readings:

1. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
2. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
3. Geneics: A Molecular Approach. 3rd edition. Peter. J. Russell.

C14P: Evolutionary Biology Lab Credits 02

List of Practical

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.

DSE-3: Endocrinology
DSE3T: Endocrinology

Credits 06
Credits 04

Unit-1: Introduction to Endocrinology

General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

Unit-2: Epiphysis, Hypothalamo-hypophysial Axis

Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland.

Unit-3: Peripheral Endocrine Glands

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Thymus, Adrenal, Pancreas, Ovary and Testis. Hormones in homeostasis, Disorders of endocrine glands

Unit-4: Regulation of Hormone Action

Mechanism of action of steroidal, non-steroidal hormones with receptors. Bioassays of hormones using RIA & ELISA. Estrous cycle in rat and menstrual cycle in human. Multifaceted role of Vasopressin & Oxytocin. Hormonal regulation of parturition.

DSE3P: Endocrinology Lab

Credits 02

List of Practical

1. Dissect and display of Endocrine glands in laboratory bred rat.
2. Study of the permanent slides of all the endocrine glands
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland
4. Estimation of plasma level of any hormone using ELISA.
5. Designing of primers of any hormone

DSE-4: Biology of Insects

Credits 06

DSE4T: Biology of Insects Credits 04

Unit-1: Introduction

General Features of Insects. Distribution and Success of Insects on the Earth.

Unit-2: Insect Taxonomy

Basis of insect classification; Classification of insects up to orders (according to Brusca and Brusca, 2016).

Unit-3: General Morphology of Insects

External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits. Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia.

Unit-4: Physiology of Insects

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system. Photoreceptors: Types, Structure and Function Metamorphosis: Types and Neuroendocrine control of metamorphosis.

Unit-5: Insect Society

Social insects with special reference to termites. Trophallaxis in social insects such as ants, termites and bees.

Unit-6: Insect Plant Interaction

Theory of co-evolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects, Major insect pests in paddy.

Unit-7: Insects as Vectors

Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important vectors

DSE4P: Biology of Insects Lab

Credits 02

1. Study of life cycle of Mosquito
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Mounting of insect wings, spiracles and genitalia of any insects
4. Methodology of collection, preservation and identification of insects.
5. Morphological studies of various castes of *Apis*, *Camponotus* *Odontotermes*
6. Study of major insect pests of paddy and their damages
7. Study of Mulberry silk moth as beneficial insect