Jiwaji University, Gwalior
B.Sc. (Hons) Zoology 2020-23
Course Structure and Scheme of Examination

First Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC-I-T	Non-chordates I: Protista to Pseudocoelomates	100	4	60	21	40	14
CC-II-T	Principles of Ecology	100	4	60	21	40	14
CC-I-P	Non-chordates I: Protista to Pseudocoelomates Lab	100	2	60	21	40	14
CC-II-P	Principles of Ecology Lab	100	2	60	21	40	14
GE-I-T	Plant Ecology and Taxonomy	100	4	60	21	40	14
AECC-I	English Communication	100	4	60	21	40	14
	Grand Total		**20**				

Second Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC-III-T	Non-chardates II: Coelomates	100	4	60	21	40	14
CC-IV-T	Cell Biology	100	4	60	21	40	14
CC-III-P	Non-chardates II: Coelomates Lab	100	2	60	21	40	14
CC-IV-P	Cell Biology Lab	100	2	60	21	40	14
GE-II-T	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	100	4	60	21	40	14
AECC-II	Environmental Science	100	4	60	21	40	14
	Grand Total		**20**				

19/10/20

Third Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC-V-T	Diversity of Chordates	100	4	60	21	40	14
CC-VI-T	Animal Physiology: Controlling and Coordinating Systems	100	4	60	21	40	14
CC-VII-T	Fundamentals of Biochemistry	100	4	60	21	40	14
CC-V-P	Diversity of Chordates Lab	100	2	60	21	40	14
CC-VI-P	Animal Physiology: Controlling and Coordinating Systems Lab	100	2	60	21	40	14
CC-VII-P	Fundamentals of Biochemistry Lab	100	2	60	21	40	14
GE-III-T	Chemistry-I	100	4	60	21	40	14
SEC-I	Apiculture	100	4	60	21	40	14
	Grand Total		**26**				

Fourth Semester

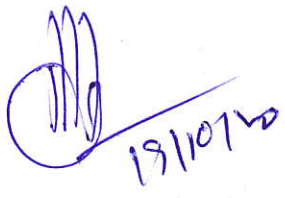
Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC-VIII-T	Comparative Anatomy of Vertebrates	100	4	60	21	40	14
CC-IX-T	Animal Physiology: Life Sustaining Systems	100	4	60	21	40	14
CC-X-T	Biochemistry of Metabolic Processes	100	4	60	21	40	14
CC-VIII-P	Comparative Anatomy of Vertebrates Lab	100	2	60	21	40	14
CC-IX-P	Animal Physiology: Life Sustaining Systems Lab	100	2	60	21	40	14
CC-X-P	Biochemistry of Metabolic Processes Lab	100	2	60	21	40	14
GE-IV-T	Chemistry-II	100	4	60	21	40	14
SEC-II	Medical Diagnostics	100	4	60	21	40	14
	Grand Total		**26**				

Fifth Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC-XI-T	Molecular Biology	100	4	60	21	40	14
CC-XII-T	Principles of Genetics	100	4	60	21	40	14
CC-XI-P	Molecular Biology Lab	100	2	60	21	40	14
CC-XII-P	Principles of Genetics Lab	100	2	60	21	40	14
DSE-I-T	Fundamental of Human Genetics	100	4	60	21	40	14
DSE-II-T	Fish and Fisheries	100	4	60	21	40	14
DSE-I-P	Fundamental of Human Genetics Lab	100	2	60	21	40	14
DSE-II-P	Fish and Fisheries Lab	100	2	60	21	40	14
	Grand Total		**24**				

Six Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC-XIII-T	Developmental Biology	100	4	60	21	40	14
CC-XIV-T	Evolutionary Biology	100	4	60	21	40	14
CC-XIII-P	Developmental Biology Lab	100	2	60	21	40	14
CC-XIV-P	Evolutionary Biology Lab	100	2	60	21	40	14
DSE-III-T	Basics of Neuroscience	100	4	60	21	40	14
DSE-IV-T	Wildlife Conservation and Management	100	4	60	21	40	14
DSE-III-P	Basics of Neuroscience Lab	100	2	60	21	40	14
DSE-IV-P	Wildlife Conservation and Management Lab	100	2	60	21	40	14
	Grand Total		**24**				



JIWAJI UNIVERSITY, GWALIOR

School of Studies in Zoology

B.Sc. Honors (2020-23)

SCHEME AND SYLLABUS FOR CHOICE BASED CREDIT SYSTEM FOR B. Sc. HONOURS ZOOLOGY

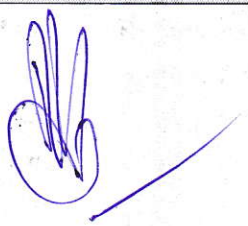
Semester	Core Course (14)	Ability Enhancemt Compulsoy Course (2)	Skill Enhancement Course SEC (2)	Discipline Specific Elective DSE (4)	Generic Elective GE (4)
I	Non-chordates I: Protista to Pseudocoelomates	English Communication			**GE-1: Botany I**
	Principles of Ecology				
II	Non-chordates II: Coelomates	Environmental Science			**GE-2: Botany II**
	Cell Biology				
III	Diversity of Chordates		**SEC -1: Apiculture**		**GE3: Chemistry I**
	Animal Physiology: Controlling and Coordinating Systems				
	Fundamentals of Biochemistry				
IV	Comparative Anatomy of Vertebrates		**SEC -2: Medical Diagnostics**		**GE-4: Chemistry II**
	Animal Physiology: Life Sustaining Systems				
	Biochemistry of Metabolic Processes				
V	Molecular Biology			DSE-1: **Fundamentals of Human Genetics**	
	Principles of Genetics			DSE-2: **Fish and Fisheries**	
VI	Developmental Biology			DSE -3: **Basics of Neuroscience**	,
	Evolutionary Biology			DSE-4: **Wild life conservation and Management**	

Semester	Course Opted	Course Name	Credits
I	Ability Enhancement Compulsory Course-I	English communications/ Environmental Science	4
	Core course-I	Non-chordates I: Protista to Pseudocoelomates	4
	Core Course-I Practical		2
	Core course-II	Principles of Ecology	4
	Core Course-II Practical		2
	Generic Elective -1	GE-1 (**Botany-I**)	4
II	Ability Enhancement Compulsory Course-II	English communications/ Environmental Science	4
	Core course-III	Non-chordates II: Coelomates	4
	Core Course-III Practical		2
	Core course-IV	Cell Biology	4
	Core Course-IV Practical		2
	Generic Elective -2	GE-2 (**Botany-II**)	4
III	Core course-V	Diversity of chordates	4
	Core Course-V Practical		2
	Core course-VI	Physiology: Controlling and Coordinating systems	4
	Core Course-VI Practical		2
	Core course-VII	Fundamentals of Biochemistry	4
	Core Course-VII Practical		2
	Skill Enhancement Course-1	SEC-1(Apiculture)	4
	Generic Elective -3	GE-3 (**Chemistry-I**)	4
IV	Core course-VIII	Comparative anatomy of vertebrates	4
	Course-VIII Practical		2
	Core course-IX	Physiology: Life Sustaining Systems	4
	Course-IX Practical		2
	Core course-X	Biochemistry of Metabolic Processes	4
	Core Course- X Practical		2
	Skill Enhancement Course-2	SEC-2 (Medical Diagnostics)	4
	Generic Elective -4	GE-4 (**Chemistry-II**)	4

Semester	Course Opted	Course Name	Credits	
V	Core course-XI	Molecular Biology	4	V
	Core Course-XI Practical		2	
	Core course-XII	Principles of Genetics	4	
	Core Course-XII Practical		2	
	Discipline Specific Elective -1	DSE-1(Fundamentals of Human Genetics)	4	
	Discipline Specific Elective -1 Practical		2	
	Discipline Specific Elective -2	DSE-2 (Basics of Neuro-Science)	4	
	Discipline Specific Elective- 2 Practical/Tutorial		2	
VI	Core course-XIII	Developmental Biology	4	
	Core Course-XIII Practical/Tutorial		2	
	Core course-XIV	Evolutionary Biology	4	
	Core Course-XIV Practical/Tutorial		2	
	Discipline Centric Elective -3	DSE-3 (Fish and Fisheries)	4	
	Discipline Centric Elective -3 Practical/Tutorial		2	
	Discipline Centric Elective-4	DSE-4 (Wildlife conservation and management)	4	
	Discipline Centric Elective -1 Practical/Tutorial		2	
			Total: 140	

CORE COURSES	
CC I	Non-chordates I: Protista to Pseudocoelomates
CC II	Principles in Ecology
CC III	Non-chordates II: Coelomates
CC IV	Cell Biology
CC V	Diversity of Chordates
CC VI	Animal Physiology: Controlling and Coordinating Systems
CC VII	Fundamentals of Biochemistry
CC VIII	Comparative Anatomy of Vertebrates
CC IX	Animal Physiology: Life Sustaining Systems
CC X	Biochemistry of Metabolic Processes
CC XI	Molecular Biology
CC XII	Principles of Genetics
CC XIII	Developmental Biology
CC XIV	Evolutionary Biology

DISCIPLINE SPECIFIC ELECTIVE COURSES	
DSE 1	Fundamentals of Human Genetics
DSE 2	Basics of Neuroscience
DSE 3	Fish and Fisheries
DSE 4	Wild Life Conservation and Management
GENERIC ELECTIVE COURSES	
GE 1	Botany-I
GE 2	Botany-II
GE 3	Chemistry-I
GE 4	Chemistry-II
SKILL ENHANCEMENT COURSES	
SEC 1	Apiculture
SEC 2	Medical Diagnostics



B. Sc Honour's I Semester

CORE COURSE I

NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES

THEORY **Credits 4)**

Unit I: Protista, Parazoa and Metazoa **19**

1. General characteristics and Classification up to classes, Study of *Euglena*, *Amoeba* and *Paramecium.*
2. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica.*
3. Locomotion and Reproduction in Protista.
4. Evolution of symmetry and segmentation in Metazoans.

Unit II: Porifera **7**

5. General characteristics and Classification up to classes.
6. Canal system of *Scypha.*
7. Reproduction in Porifera, Spicules in sponges, Affinities of Porifera.
8. Distribution and mode of occurrence of sponges; Economic importance.

Unit III: Cnidaria and Ctenophora **12**

9. General characteristics and Classification up to classes.
10. Locomotion in hydra, Alternation of generation and metagenesis in *Obelia.*
11. Polymorphism in cnidaria, Corals and coral reefs.
12. General characteristics, classification up to classes, Evolutionary significance Ctenophora and Affinities of Ctenophora.

Unit IV: Platyhelminthes **10**

13. General characteristics and Classification up to classes.
14. Life Cycle of *Fasciola hepatica* and *Taenia solium.*
15. Study of Reproductive system of *Fasciola hepatica.*
16. Pathogenicity of *Fasciola hepatica* and *Taenia solium.*

Unit V: Aschelminthes and Nemathelminthes **8**

17. General characteristics and Classification up to classes.
18. Life cycle and pathogenicity of *Ascaris lumbricoides.*
19. Life cycle and pathogenicity of *Wuchereria bancrofti.*
20. Parasitic adaptations in helminths.

Note: Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES

PRACTICALS (Credits2)

1. Study of whole mount of *Euglena*, *Amoeba* and *Paramecium,* Binary fission and Conjugation in *Paramecium.*
2. Examination of pond water collected from different places for diversity in Protista.
3. Study of *Sycon* (T.S. and L.S.), *Hyalonema, Euplectella, Spongilla.*
4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora.*
5. One specimen/slide of any ctenophore.
6. Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/micro-photographs).
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs).
8. To submit a Project Report on any related topic on lifecycles/coral/coral reefs.

Note: Classification to be followed from "Ruppert and Barnes (2006) Invertebrate *Zoology*, 8th edition, Holt Saunders International Edition."

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science.
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson.
- Jordan, E.L. and Verma, P.S. *Invertebrate Zoology.* S. Chand and Company.

CORE COURSE II

PRINCIPLES OF ECOLOGY

THEORY **(Credits 4)**

Unit I: Introduction to Ecology **6**

1. History of ecology.
2. Autecology and synecology.
3. Levels of organization, Laws of limiting factors.
4. Study of physical factors.

Unit II: Population **24**

5. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.
6. Exponential and logistic growth of population, equation and patterns, r and K strategies
7. Population interactions, Gause's Principle with laboratory and field examples.
8. Lotka-Volterra equation for competition and Predation, functional and numerical responses.

Unit III: Community **12**

9. Community characteristics: species richness, dominance, diversity, abundance and vertical stratification.
10. Ecotone and edge effect.
11. Ecological succession with one example.

Unit IV: Ecosystem **14**

12. Basic concept: Types of ecosystems with one example.
13. Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains.
14. Food web, Energy flow through the ecosystem.
15. Ecological pyramids and Ecological efficiencies.

Unit V: Applied Ecology **4**

16. Ecology in Wildlife Conservation and Management.
17. Act and Legislation of wildlife conservation.
18. Nutrient and biogeochemical cycle with on example of Nitrogen cycle.
19. Zoo-geographical region of wildlife distribution.

PRINCIPLES OF ECOLOGY

PRACTICALS **(Credits 2)**

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 quadrate 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 CO_2.
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.

SUGGESTED READINGS

1. Colinvaux, P.A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole.
4. Robert Leo Smith Ecology and field biology Harper and Row publisher.
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press.

Paper code: AECC-I English Communication

Total Hours : 30

Credits: 4

Unit – I: Introduction

1. Theory of Communication
2. Types and modes of Communication

Unit – II: Language of Communication

3. Verbal and Non-verbal (Spoken and Written),
4. Personal, Social and Business
5. Barriers and Strategies
6. Intra-personal, Inter-personal and Group communication

Unit – III: Speaking Skills

7. Monologue
8. Dialogue
9. Group Discussion
10. Effective Communication/ Mis- Communication
11. Interview
12. Public Speech

Unit – IV: Reading and Understanding

13. Close Reading
14. Comprehension
15. Summary Paraphrasing
16. Analysis and Interpretation
17. Translation (from Indian language to English and vice-versa)
18. Literary/Knowledge Texts

Unit – V: Writing Skills

19. Documenting
20. Report Writing
21. Making notes
22. Letter writing

Course Outcome:

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions.

Text Books:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. Ranjana Kaul, Dr. Brati Biswas

Generic Elective: GE-1

Plant Ecology and Taxonomy

(Credits: Theory-4)

THEORY **Lectures: 60**

Unit I: Introduction, Ecological factors and Plant communities **(12)**

1. History and introduction and Ecology Soil: Origin, formation, composition, soil profile.
2. Water: States of water in the environment, precipitation types.
3. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance.
4. Adaptation of hydrophytes and xerophytes.
5. Characteristic feature plant communities,

Unit II: Ecosystem, Biogeochemical cycle and Phytogeography **(12)**

6. Ecotone and edge effect; Succession; Processes and types.
7. Structure; energy flow trophic organization; Food chains and food webs.
8. Ecological pyramids production and productivity.
9. Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous.
10. Principle biogeographical zones; Endemism.

U nit III: Introduction to plant taxonomy, Herbarium and taxonomic evidences **(14)**

11. Identification, Classification, Nomenclature. Functions of Herbarium, technique of preparation of Herbarium important herbaria and botanical gardens of the world and India.
12. Documentation: Flora, Keys: single access and multi-access.
13. Taxonomy in relation to cytology.
14. Phytochemistry and Palynology.

Unit IV: Botanical nomenclature and Typification **(10)**

15. Principles and rules (ICN); ranks and names.
16. Binominal system.
17. Typification, author citation, valid publication, rejection of names.
18. Principle of priority and its limitations.

Unit V: Types of Classification **(12)**

19. Types of classification-artificial, natural and phylogenetic. Bentham and Hooker, Engler and Prantl and Hutchinson (upto series).

B. Sc Honour's II Semester

CORE COURSE III

NON-CHORDATES II: COELOMATES

THEORY **(Credits 4)**

2

Unit I: Introduction to Coelomates

1. Evolution of coelom
2. Metamerism in coelomates
3. Coelom formation
4. Significance of coelom

10

Unit II: Annelida

5. General characteristics and Classification up to classes.
6. Nervous system of Annelida (earthworm).
7. Metamerism in Annelida, Excretion in Annelida.
8. Reproductive organs of Annelida (Earthworm).
9. Significance of trochophore larva.

17

Unit III: Arthropoda

10. General characteristics and Classification up to classes.
11. Sensory and Nervous system of *Prawn.*
12. Larval forms of Crustacea.
13. Metamorphosis in Insects Social life in bees and termites.
14. Reproduction in Arthropoda.

Unit IV: Mollusca

15. General characteristics and Classification upto classes Respiration in Mollusca.
16. Torsion and detorsion in Gastropoda, Pearl formation in bivalves.
17. Larval forms of Mollusca.
17. Nervous system of Pila.

Unit V: Echinodermata **12**

21. General characteristics and Classification up to classes.
22. Water-vascular system in Asteroidea.
23. Larval forms in Echinodermata.
24. Affinities with Chordates.

Note: Classification to be followed from "Ruppert and Barnes (2006) Invertebrate *Zoology*, 8th edition, Holt Saunders International Edition"

NON-CHORDATES II: COELOMATES

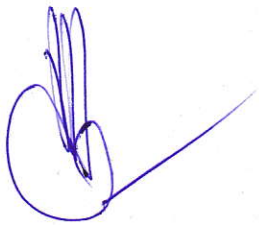
PRACTICAL **(Credits 2)**

1. Study of following specimens:
   Annelids-*Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria.*
   Arthropods - *Limulus*, *Palamnaeus, Palaemon, Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta,* termites and honey bees Onychophora, *Peripatus.*
   Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus.*
   Echinodermates – *Pentaceros /Asterias, Ophiura, Clypeaster, Echinus, Cucumaria* and *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 americana.*
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm

Note: Classification to be followed from "Ruppert and Barnes (2006) Invertebrate *Zoology*, 8th edition, Holt Saunders International Edition"

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
- Barnes, R. S. K., Calow, P., Olive, P. J. W., Golding, D. W. and Spicer, J. I. (2002). *The Invertebrates: A New Synthesis,* III Edition, Blackwell Science.
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson.



CORE COURSE IV

CELL BIOLOGY

THEORY **(Credits 4)**

Unit-I: Organization and functions of cell

1. Comparison of a generalized prokaryotic and eukaryotic cell.
2. Elementary knowledge of structure and function of plasma membrane.
3. Introduction to endo membrane system (endoplasmic reticulum, Golgi complex, lysosome), peroxisome.
4. Apoptosis.

Unit-II: Organization of cell

5. Structure and functions of mitochondria.
6. Nuclear envelope, nucleolus and biogenesis of ribosome.
7. Interphase chromatin and its compaction into metaphase chromosome.
8. Introduction to polytene and lamp brush chromosomes.

Unit-III: Cell Reproduction

9. Methods in Cell biology: Elementary idea of microscopy and cell fractionation.
10. Basic features of cell cycle.
11. Mitosis, mitotic spindle and chromosome movement.
12. Process and phases of meiosis and its significance.
13. Regulation of cell cycle.

Unit-IV: Cell surface

14. Cytoskeleton.
15. General idea of Cell signaling molecules and signal transduction pathway (GPCR).
16. Cell Junctions, Cell Adhesion molecules and cell-cell Interaction.
17. An elementary idea of Cell transformation, malignancy and Cancer.

Unit-V:

18. Introduction to immune system.
19. Types of immunity: Adaptive and Innate immunity.
20. Immune cells, cell mediated and humoral immunity.
21. Antibody: Structure and function.

CELL BIOLOGY

PRACTICAL **(Credits 2)**

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 blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
   i) DNA by Feulgen reaction.
   ii) DNA and RNA by MGP.
   iii) Mucopolysaccharides by PAS reaction.
   iv) Proteins by Mercuro bromo phenol blue/Fast Green.

SUGGESTED READINGS

1. Alberts *et al*: Molecular Biology of the Cell (2008, Garland)
2. Lodish *et al*: Molecular Cell Biology (2008, Freeman)
3. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Becker, W.M., Klein smith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
7. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.

AECC2: Environmental Science

Total Hours : 30 **Credits: 4**

Unit I:Introduction to Environmental Studies

1. Multidisciplinary nature of environmental studies
2. Definition, Nature, Scope and Importance of environmental studies
3. Types and Components of environment
4. Concept of sustainability and sustainable development

Unit II: Ecosystems

5. Introduction of Eco-system, Structure and Function of ecosystem
6. Energy flow in an ecosystem: food chains, food webs and ecological succession
7. Case studies of the following ecosystem: (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (pons, streams, lakes, rivers, oceans, estuaries)

Unit III: Natural Resources: Renewable and Non- Renewable Resources

8. Land resources and land use change; Land degradation, soil erosion and desertification.
9. Deforestation: Causes and impacts due to mining, dam building on environment, forests, Biodiversity and tribal populations.
10. Water: Use and over---exploitation of surface and ground water, floods, droughts, conflicts Over water (international & inter---state).
11. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit IV: Biodiversity and conservation

12. Levels of biological diversity: genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots. India as a megabiodiversity nation; Endangered and endemic species of India.
13. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions
14. Conservation of biodiversity: In situ and Ex situ conservation of biodiversity
15. Environmental Pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks.

Unit V: Environmental Policies & Practices

16. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture
17. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
19. Nature reserves, tribal populations and rights.

SUGGESTED READINGS

1. Carsen, R. 2002. Silent Spring, Houghton Mifflin,Harcourt.
2. Rao, M. N & DattaA.K.1987.Waste Water Treatment, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Raven, P.H Hassenzahl, D.M. & Berg L.R, 2012 Environment.8thEdition. John Wiley & Sons.
4. Singh, J.S.Singh, S.P. and Gupta, S.R. 2014.Ecology, Environmental Science and Conservation. S. Chand Publishing, NewDelhi.
5. Agarwal, K.C.2001 Environmental Biology, Nidi Publication .Ltd.Bikaner.
6. BharuchaErach, The Biodiversity Biology of India, Mapin Publishing Pvt. Ltd. Ahmedbad,India
7. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia. Jaico Publ. House.Mumbai.1196p.
8. Heywood,V.h & Watson,R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.
9. Jadhav, H & BhosaleV.M.1995. Environmental Protection and Laws, Himalaya Publishing House, Delhi
10. Mckinney, M. L. & Schoch. R. M.1996. Environmental Science systems & Solutions, Web enhanced edition.
11. Saha T. K. 2010. Ecology and Environmental Biology, Books and Allied (P) Ltd. Kolkata.
12. Santra S.C. 2005. Environmental Science, New Central Book Agency (P) Ltd. Kolkata.

Generic Elective GE-2

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

(Credits: Theory-4)

THEORY

Unit 1: Microbes- History and their types **(10)**

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

Unit 2: Algae **(12)**

5. General characteristics; Ecology and distribution
6. Range of thallus organization and reproduction; Classification of algae;
7. Morphology and life-cycles of the following: *Volvox*, *Chlamydomonas, Oedogonium*, *Vaucheria* and *Polysiphonia*.
8. Economic importance of algae.

Unit 3: Fungi (12 lectures)

9. Introduction- General characteristics, ecology and significance
10. range of thallus organization, cell wall composition, nutrition, reproduction and classification
11. True Fungi- General characteristics, ecology and significance
12. Life cycle of *Rhizopus* (Zygomycota) *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota)
13. Symbiotic Associations-Lichens: General account, reproduction and significance
14. Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit 4: Introduction to Archegoniate and Bryophytes **(12)**

15. Unifying features of archegoniates, Transition to land habit, Alternation of generations.
16. General characteristics of Bryophytes adaptations to land habit, Classification, Range of thallus organization.
17. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* (Developmental details not to be included).
18. Ecology and economic importance of bryophytes.

U nit 5: Pteridophytes and Gymnosperms **(14)**

19. General characteristics, classification of Pteridophytes and Gymnosperms Early land plants (*Rhynia*).
20. Classification (up to family), morphology, anatomy and reproduction of *Selaginella* and *Equisetum*. (Developmental details not to be included).
21. Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.
22. Morphology, anatomy and reproduction of *Cycas* and *Pinus* (Developmental details not to be included).
23. Ecological and economical importance.

B. Sc Honour's III Semester
CORE COURSE V

DIVERSITY OF CHORDATES

THEORY **(Credits 4)**

Unit I: Protochordata **8**

1. General characteristics of Hemichordata, Urochordata and Cephalochordata.
2. Study of larval forms in Protochordates.
3. Retrogressive metamorphosis in Urochordata.
4. Affinities of Protochordata, Urochordata and Cephalochordata.

Unit II: Agnatha, Pisces and Amphibia **2**

5. General characteristics and classification of cyclostomes up to class.
6. General characteristics of Chondrichthyes and Osteichthyes, classification upto order Migration, Osmoregulation and Parental care in fishes.
7. Origin of *Tetrapoda* (Evolution of terrestrial ectotherms).
8. Parental care in Amphibians.

Unit III: Reptilia **7**

9. General characteristics and classification up to order.
10. Affinities of *Sphenodon.*
11. Poison apparatus and Biting mechanism in snakes.
12. Skull in Reptiles.

Unit IV: Aves **8**

13. General characteristics and classification up to order *Archaeopteryx*- a connecting link; Principles and aerodynamics of flight.
14. Flight adaptations.
15. Migration in birds.
16. Flightless birds.

Unit V: Mammals **8**

17. General characters and classification up to order.
18. Affinities of Prototheria.
19. Adaptive radiation with reference to locomotory appendages.
20. Origin and evolution in mammals.

DIVERSITY OF CHORDATES

PRACTICAL **(Credits 2)**

1. **Protochordata**
   Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchio genital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slide of *Herdmania* spicules.

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**
   Ichthyophis /Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra.

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. **Aves**
   Study of six common birds from different orders. Types of beaks and claws.

7. **Mammalia**

- *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes, Erinaceous.*
- Mount of weberian ossicles of *Mystus,* pecten from Fowl head.
- Dissection of Fowl head (Dissections and mount subject to permission).
- Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission).

Classification from Young, J. Z. (2004) to be followed.

SUGGESTED READINGS

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

CORE COURSE VI

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

THEORY **Credits 4)**

Unit I: Tissues **6**

1. Structure, locations of tissue.
2. Classification and functions of epithelial tissue.
3. Connective tissue, muscular tissue and nervous tissue.

Unit II: Bone, Cartilage and Muscle **4**

4. Structure and types of bones and cartilages.
5. Ultra-structure of skeletal muscle.
6. Chemical basis of muscle contraction.
7. Muscular disorders.

Unit III: Nervous System **10**

8. Structure and type of neuron.
9. Resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers.
10. Types of synapse, Synaptic transmission and, Neuromuscular junction.
11. Reflex action and its types - reflex arc.
12. Physiology of hearing and vision.

Unit IV: Reproductive System **10**

13. Histology of testis and ovary.
14. Physiology of male Reproduction.
15. Physiology of female reproduction.
16. Methods of contraception in male and female.

Unit V: Endocrine System **18**

17. Structure and function of endocrine glands-pineal, pituitary, thyroid, parathyroid, pancreas, adrenal.
18. Hormonal regulation by hypothalamus.
19. Classification of hormones.
20. Placental hormones.

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

PRACTICALS **(Credits2)**

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

(*Subject to UGC guidelines)

SUGGESTED BOOKS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Her court Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley &sons
- Victor P. Eros chenko. (2008). DiFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &Wilkins.

CORE COURSE VII

FUNDAMENTALS OF BIOCHEMISTRY

THEORY **(CREDITS 4)**

Unit-I: Introduction

1. Scope and importance of Biochemistry.
2. Principle of biomolecular organization, configuration and conformation.
3. Water as biological solvent.
4. Water soluble and lipid soluble Vitamins.

Unit-II: Amino acid

5. Structure and classification.
6. Properties of peptide bond.
7. Proteins.
8. Functions and diversity.
9. Structural organization.

Unit-III: Enzymes

10. General properties.
11. Major classes of enzymes.
12. Mechanism of enzyme action (ES complex and lowering of activation energy, concept of chemical catalysis).
13. Hormones: general properties and classification.
14. Mechanism of hormone action.

Unit-IV: Carbohydrates and lipids

15. Classification.
16. Structure and conformation of monosaccharides.
17. Reducing and non-reducing sugars.
18. Oligo saccharides (disaccharides) and polysaccharides.
19. Biological significance and classification of Lipids.
20. Fatty acids: Types and nomenclature.
21. Formation of lipid bilayer.

Unit-V Nucleic acids

22. Bases, nucleosides and nucleotides.
23. DNA structure: DNA double helix (Watson and Crick model).
24. DNA and RNA as genetic material.
25. DNA replication: Semi-conservative replication, Basic mechanism (Prokaryotes).
26. Transcriptional unit and basic concept of transcription (Prokaryotes).
27. Genetic code and basic mechanism of translation (Prokaryotes).

FUNDAMENTALS OF BIOCHEMISTRY

PRACTICAL **(CREDITS 2)**

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE.

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). *Harper's Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

SKILL ENHANCEMENT COURSES
SEC -1

APICULTURE

(CREDITS 4)

Unit I: Biology of Bees **(4)**

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

Unit II: Rearing of Bees **(10)**

3. Artificial Bee rearing (Apiary), Beehives–Newton and Langstroth Bee Pasturage.
4. Selection of Bee Species for Apiculture Bee Keeping Equipment.
5. Methods of Extraction of Honey (Indigenous and Modern).

Unit III: Diseases and Enemies **(5)**

6. Bee Diseases and Enemies.
7. Control and Preventive measures.

Unit IV: Bee Economy **(2)**

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

Unit V: Entrepreneurship in Apiculture **(4)**

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

SUGGESTED READINGS

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Bisht D.S., *Apiculture*, ICAR Publication.
- Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.

Generic Elective-3: Chemistry-I (Theory)

[Course will be Offered by School of Studies in Chemistry]

Total Hours : 60 **CREDITS: 4**

Unit-I Atomic Structure & Elementary Quantum Mechanics:

1. **Quantum Numbers Shapes of s, p, d, f orbitals**. Aufbau principle and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.
2. Dual nature of Electron, Photo Electric Effect, Compton effect, Idea of the de-Broglie matter waves, Heisenberg Uncertainty principle, Bohr's Model of Hydrogen atom (no derivation) and its defects.
3. **Molecular orbital theory, basic ideas**: Criteria for forming M.O, construction M.O's by LCAO-$H2^+$ ion calculation of energy levels from wave functions, concept of σ, σ^*, π, π^* & n orbitals and their characteristics.
4. Hybrid orbitals – (sp, sp^2, sp^3), calculation of co-efficient of A.O.'s used in these hybrid orbitals. Schrödinger wave equation, Significance of ψ and $\psi 2$.

Unit-II Periodic Properties & Bonding

5. Atomic and ionic radii, ionization energy, electron affinity and electro negativity definition, methods of determination
6. Trends in periodic table and applications in predicting and explaining the chemical behaviour.
7. Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to NH_3, H_3O^+ and H_2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro negativity difference.
8. Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, Lattice defects, Semiconductors, Lattice energy and Born-Haber cycle, Solvation energy and Solubility of Ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond: free electron, valence bond and bond theories.
9. Weak Interactions –: Hydrogen bonding, Vander Waals forces.

Unit-III Basics of Organic Chemistry and Stereochemistry

10. Basics of Organic Chemistry: *Organic Compounds:* Classification, Hybridization, Shapes of molecules.
11. Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and hyperconjugation. Homolytic and Heterolytic fission with suitable examples.Electrophiles and Nucleophiles.
12. Stereochemistry: Fischer Projection and Newmann Projection formulae Geometrical isomerism: cis–trans and, syn-anti isomerism.
13. Optical Isomerism*: Criteria for* Optical Activity, Enantiomers and Distereoisomers, meso structures, Threo and Erythro isomers.

Unit-IV Aliphatic Hydrocarbons

14. Chemistry of alkanes: Formation of alkanes, Wurtz Reaction
15. Carbon-Carbon pibonds:Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions.
16. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition) and Diels-Alder reaction.
17. Reactions of alkynes: Electrophilic and Nucleophilic additions.

Unit-V Cycloalkanes

18. Types of cycloalkanes and their relative stability
19. Conformation analysis of alkanes: Chair, Boat and Twist boat forms; Relative stability
20. Aromatic hydrocarbons:Electrophilic aromatic substitution: halogenation, nitration
21. Ssulphonation and Friedel-Craft's alkylation/acylation with their mechanism.

B. Sc IV Semester

CORE COURSE VIII

COMPARATIVE ANATOMY OF VERTEBRATES

THEORY **(CREDITS 4)**

Unit I: Integumentary System and Skeletal System **8**

1. Structure and functions of integument.
2. Derivatives of integument
3. Overview of axial and appendicular skeleton.
4. Jaw suspensorium.
5. Visceral arches.

Unit II: Digestive System and Respiratory System **8**

6. Alimentary canal, associated glands and dentition.
7. Respiratory organs: Skin, gills, lungs, air sacs.
8. Accessory respiratory organs.

Unit III: Circulatory System **8**

9. General plan of circulation.
10. Evolution of heart.
11. Aortic arches.

Unit IV: Urinogenital System **6**

12. Succession of kidney.
13. Evolution of urinogenital ducts.
14. Types of mammalian uteri.

Unit V: Nervous System and Sense Organs **8**

15. Comparative account of brain.
16. Autonomic nervous system, Spinal cord, Cranial nerves in mammals.
17. Classification of receptors.
18. Brief account of visual and auditory receptors in man.

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL **(CREDITS 2)**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Disarticulated skeleton of Frog, *Varanus,* Fowl, Rabbit.
3. Carapace and plastron of turtle/tortoise.
4. Mammalian skulls: One herbivorous and one carnivorous animal.
5. Dissection of rat to study arterial and urinogenital system (subject to permission)
6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted).
7. Project on skeletal modifications in vertebrates (may be included if dissection not permitted).

SUGGESTED READINGS

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- Hilder brand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.

CORE COURSE IX

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

THEORY **(Credits 4)**

Unit I: Physiology of Digestion **14**

1. Structural organization and functions of gastro intestinal tract and associated glands.
2. Mechanical and chemical digestion of food: Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins.
3. Hormonal control of secretion of enzymes in Gastro intestinal tract.

Unit II: Physiology of Respiration **12**

4. Histology of trachea and lungs.
5. Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities.
6. Transport of oxygen and carbon dioxide in blood.
7. Respiratory pigments, Dissociation curves and the factors influencing it, Carbon monoxide poisoning, Control of respiration.

Unit III: Renal Physiology **8**

8. Structure of kidney and its functional unit.
9. Mechanism of urine formation.
10. Regulation of water balance.
11. Regulation of acid-base balance.

Unit IV: Blood **14**

12. Components of blood and their functions.
13. Structure and functions of hemoglobin.
14. Hemostasis: Blood clotting system, Complement system & Fibrinolytic system, Hemopoiesis
15. Blood groups: Rh factor, ABO and MN.

Unit V: Physiology of Heart **12**

16. Structure of mammalian heart, Coronary circulation.
17. Structure and working of conducting myocardial fibers.
18. Origin and conduction of cardiac impulses Cardiac cycle: Cardiac output and its regulation.
19. Frank-Starling Law of the heart, Electrocardiogram, Blood pressure and its regulation.

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS

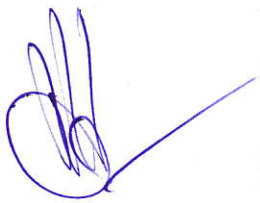
(CREDITS2)

1. Determination of ABO Blood groups.
2. Enumeration of red blood cell sand white blood cells using hemocytometer.
3. Estimation of hemoglobin using Sahli'shaemoglobinometer.
4. Preparation of haemin and haemo chromogen crystals.
5. Recording of frog's heart beat under *in situ* and perfused conditions.
6. Recording of blood pressure using a sphygmomanometer.
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.

(*Subject to UGC guidelines)

SUGGESTED READINGS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Her court Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
- Victor P. Eroschenko. (2008). DiFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &Wilkins.
- Vander, A., Sherman, J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills.



CORE COURSE X

BIOCHEMISTRY OF METABOLIC PROCESSES

THEORY **(CREDITS 4)**

Unit 1: Overview of Metabolism **10**

1. Catabolism *vs* Anabolism, Stages of catabolism.
2. Compartmentalization of metabolic pathways.
3. Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions.
4. Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms.

Unit 2: Carbohydrate Metabolism **16**

5. Sequence of reactions and regulation of glycolysis.
6. Citric acid cycle.
7. Phosphate pentose pathway.
8. Gluconeogenesis.
9. Glycogenolysis and Glycogenesis.

Unit 3: Lipid Metabolism **14**

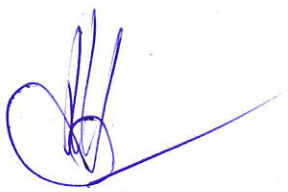
10. β-oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms.
11. Biosynthesis of palmitic acid.
12. Ketogenesis.

Unit 4: Protein Metabolism **10**

13. Catabolism of amino acids: Transamination, Deamination.
14. Urea cycle.
15. Fate of C-skeleton of Glucogenic and Ketogenic amino acids.

Unit 5: Oxidative Phosphorylation **10**

16. Redox systems: Review of mitochondrial respiratory chain.
17. Inhibitors and un-couplers of Electron Transport System.



BIOCHEMISTRY OF METABOLIC PROCESS

PRACTICALS **(CREDITS 2)**

1. Estimation of total protein in given solutions by Lowry's method.
2. Detection of SGOT and SGPT or GST and GSH in serum/tissue
3. To study the enzymatic activity of Trypsin and Lipase.
4. Study of biological oxidation (SDH) [Goat liver]
5. To perform the Acid and Alkaline phosphatase assay from serum/tissue.
6. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO_2 in the TCA cycle.

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, *D.A.,* Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). *Harper's Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.

SEC 2

MEDICAL DIAGNOSTICS

THEORY **(Credits 4)**

Unit I: Non-infectious and Infectious Diseases:

1. Introduction to Medical Diagnostics and its Importance.
2. Non-infectious disease: Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary): Testing of blood glucose using Glucometer/Kit
3. Infectious disease: Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit II: Molecular Methods for diagnosis of genetic diseases.

4. Principle of polymerase chain reaction.
5. Principle and methods of RT-PCR & QRT- PCR.
6. Application of various PCR methods in detection of DNA mutations and abnormal gene functions, with examples.
7. Electrophoretic methods of detection of hematological abnormalities.
8. Cancer (Tumor): Types (Benign/Malignant), Detection and metastasis;

Unit-III: Cytogenetic methods for diagnosis of genetic diseases.

9. History of human cytogenetics
10. Human chromosomes, karyotyping and preparation of ideogram.
11. Methods of lymphocyte culture and metaphase chromosome preparation.
12. Identification and nomenclature of abnormal chromosomes and related diseases.

Unit IV: Diagnostic Methods for Analysis of Blood & Urine

13. Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using hemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.), etc.
14. Urine Analysis: Physical characteristics; Abnormal constituents of urine. Method of analysis of glucose and other clinical parameters in urine.

Unit V: Medical Tools: Working principle and applications of:

15. X-Ray and detection of Bone fracture, PET, MRI and CT- Scan (using photographs).
16. Spectrophotometer & blood analyzer.

Generic Elective-4: CHEMISTRY-II (Theory)
[Course will be offered by School of Studies in Chemistry]

Total Hours : 60

CREDITS: 4

Unit-I Chemical Energetics

1. Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry.
2. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.
3. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.
4. Chemical Equilibrium: Free energy change in a chemical reaction.

Unit-II Chemical and Ionic Equilibrium

5. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and Δ Go , Le Chatelier's principle.
6. Relationships between Kp, Kc and Kx for reactions involving ideal gases. (8 Lectures)
7. Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization
8. Ionization constant and ionic product of water.

Unit-III Acid, Base, Buffers and Aromatic hydrocarbons

9. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.
10. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.
11. Functional group approach for the following reactions to be studied in context to their structure. Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Unit-IV Chemical Reactions, Alkyl and Aryl Halides

12. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation.
13. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).
14. Alkyl and Aryl Halides Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. Preparation: from alkenes and alcohols.
15. Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs substitution. Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Unit-V Reactions of alcohols, phenol, aldehydes and ketones

16. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3).
17. Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.
18. Alcohols, Phenols and Ethers (Upto 5 Carbons) Alcohols: Preparation: Preparation of 1o , 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3).

19. Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. Ethers (aliphatic and aromatic): Cleavage of ethers with HI.
20. Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation.

SUGGESTED READINGS

1. Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988)
4. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S. • Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
5. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010. •Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
6. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
7. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).•Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
8. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

B. Sc Vth Semester

CORE COURSE XI

MOLECULAR BIOLOGY

THEORY **(CREDITS 4)**

Unit I: Nucleic Acids and DNA Replication **4**

1. Salient features of DNA and RNA.
2. Watson and Crick model of DNA.
3. DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming.
4. Replication of circular and linear *ds*-DNA, replication of telomeres

Unit II: Transcription and Gene Regulation **10**

5. RNA polymerase and transcription Unit.
6. mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors.
7. Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon.
8. Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting.

Unit III: Translation

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

Unit IV: Post Transcriptional Modifications and Processing of Eukaryotic RNA **6**

13. Structure of globin mRNA.
14. Split genes: concept of introns and exons.
15. splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA.

Unit V: DNA Repair Mechanisms and Regulatory RNAs **10**

16. Pyrimidine dimerization and mismatch repair.
17. Ribo-switches, RNA interference, miRNA, siRNA.

MOLECULAR BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae.
2. Preparation of liquid culture medium (LB)and raise culture of *E.coli.*
3. Estimation of the growth kinetics of *E. coli* by turbidity method.
4. Preparation of solid culture medium (LB) and growth of *E.coli* by spreading and streaking.
5. Demonstration of antibiotic sensitivity/resistance of *E.coli* to antibiotic pressure and interpretation of results.
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260measurement).
7. Quantitative estimation of RNA using Orcinol reaction.
8. Study and interpretation of electron micrographs/ photograph showing
   (a) DNA replication
   (b) Transcription
   (c) Split genes

SUGGESTED READINGS

- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G.P. (2009). *The World of the Cell.* VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
- Cooper G.M. and Robert E. R.E *The Cell: A Molecular Approach,* V Edition, ASM Press and Sinauer Associates.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- Lewin B. (2008). *Gene XI*, Jones and Bartlett.
- McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition.GS, Taylor and Francis Group, NewYork and London.

CORE COURSE XII

PRINCIPLES OF GENETICS

THEORY **(CREDITS 4)**

Unit I: Mendelian Genetics and its Extension **8**

1. Principles of inheritance, Incomplete dominance and co-dominance.
2. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy.
3. Sex-linked, sex- influenced and sex-limited characters inheritance.
4. Polygenic inheritance with suitable examples; simple numerical based on it.
5. Chromosomal mechanisms of sex determination in Drosophila and Man.

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

6. Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination
7. Recombination frequency as a measure of linkage intensity
8. Two factor and three factor crosses, Interference and coincidence
9. Somatic cell hybridization.

Unit III: Mutations **4**

10. Types of gene mutations (Classification).
11. Types of chromosomal aberrations (Classification, figures and with one suitable example of each).
12. Molecular basis of mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, attached *X* method.

Unit IV: Extra-chromosomal Inheritance, Polygenic Inheritance **6**

13. Criteria for extra-chromosomal inheritance.
14. Antibiotic resistance in *Chlamydomonas.*
15. Mitochondrial mutations in *Saccharomyces.*
16. Infective heredity in *Paramecium* and Maternal effects.

Unit 5: Recombination in Bacteria and Viruses, Transposable Genetic Elements **9**

17. Conjugation, Transformation, Transduction.
18. Complementation test in Bacteriophage.
19. Transposons in bacteria.
20. Ac-Ds elements in maize and P elements in Drosophila.
21. Transposons in humans.

PRINCIPLES OF GENETICS

PRACTICALS **(CREDITS 2)**

1. To study the Mendelian laws and gene interactions.
2. Chi-square analyses using seeds/beads/*Drosophila*.
3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from *Drosophila* crosses.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.
7. Field collection and laboratory culture of *Drosophila*.
8. Study of male, female and somatic mutant phenotypes in *Drosophila*.

SUGGESTED READINGS

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

DSE-1- BOZ-
Fundamentals of Human Genetics

(CREDITS 4)

Unit I

1. History of Human Genetics
2. Pedigrees- gathering family history. pedigree symbols, construction of pedigrees;
3. Pedigree analysis of monogenic traits:
3.1 Autosomal inheritance-dominant, recessive
3.2 Sex-linked inheritance- X-linked recessive, dominant; Y -linked
3.3 Sex-limited and sex-influenced traits
3.4 Mitochondrial inheritance
3.5 MIM number

Unit II

4. Human Cytogenetics
4.1 Origins and developments in the study of human cytogenetics
4.2 Chromosome banding: Principle, methods and application (G, C, Q, R, T and NOR banding)
4.3 Molecular techniques in human chromosome analysis (FISH, GISH, CGH, SKY)
5. Human chromosomal pathologies:
5.1 Numerical aberrations and their common syndromes
5.2 Structural aberrations and their common syndromes (translocations, duplications, deletions, microdeletion syndromes, fragile sites, etc.)
6. Human Karyotype and banding patterns, ideogram, nomenclature of banding

Unit III

7. Dosage compensation in mammals
7.1 Lyon's Hypothesis, Sex chromatin
7.2 Molecular mechanism of X-chromosome inactivation
8. Sex determination in Mammals
8.1 Molecular Mechanism of sex determination
8.2 Secondary sex determination

Unit IV

9. Cancer: General idea of Oncogenes and Tumor suppressor genes
9.1. Chromosomal basis of Cancer: CML (Philadelphia chromosome)
9.2. Epigenetic Mechanisms: DNA Methylation
10. Organization of human genome:
10.1 Mitochondrial genome
10.2 Nuclear genome -Gross base composition, gene density, repeated DNA

Unit V

11. Genetic mapping of Mendelian characters
11.1 Genetic markers
11.2 Two-point mapping- LOD score analysis
12. History, HGP organization and goals of human genome project, ELSI
13. Human Development
13.1 Differentiation of Germ cells and Gametogenesis in human
13.2 Fertilization, ovulation and implantation in human

Discipline Specific Elective – 1 Practical
Fundamentals of Human Genetics

PRACTICALS **(CREDITS 2)**

1. Collection handling, laboratory culture and life cycle study of drosophila
2. Preparation of pedigree chart for common phenotypic characters of Human.
3. Karyotyping and ideogram preparation of human chromosomes.
4. Study of Mutants in drosophila
5. Molecular detection of genetic diseases
6. Study of various stages of human fetal development based on model
7. Genomic DNA extraction form Human/mouse/fly tissues
8. Quantitation of DNA and electrophoretic separation\
9. Study of various chemical and morphological features of genetic disorders in human.
10. G and C banding of Mammalian chromosomes
11. Spotting; Study of various photographs/ Model/ Slides

Discipline Specific Elective DSE -2

FISH AND FISHERIES

THEORY **(Credits 4)**

Unit 1: Introduction and Classification: **6**

General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

Unit 2: Morphology and Physiology: **18**

Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration

Unit 3: Fisheries **12**

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

Unit4: Aquaculture **20**

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture offish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Unit 5: Fish in research **4**

Transgenic fish, Zebrafish as a model organism in research

FISH AND FISHERIES

PRACTICAL **(Credits2)**

1. Morphometric and meristic characters of fishes
2. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera, Exocoetus*, *Hippocampus*, *Gambusia, Labeo, Heteropneustes, Anabas*
3. Studyofdifferenttypesofscales(throughpermanentslides/photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Study of air breathing organsin *Channa, Heteropneustes, Anabas* and *Clarias*
7. Demonstration of induced breeding in Fishes(video)
8. Demonstration of parental care in fishes(video)
9. ProjectReportonavisittoanyfishfarm/pisciculture unit/Zebrafishrearing Lab.

SUGGESTED READINGS

- QBoneandRMoore,BiologyofFishes,TalyorandFrancisGroup,CRCPress,U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group,CRCPress,UKvonderEmde,R.J.MogdansandB.G.Kapoor.TheSensesof Fish:AdaptationsfortheReceptionofNaturalStimuli,Springer,Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra PublishingHouse
- J.R. Norman, A history of Fishes, Hill and WangPublishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra PublishingHouse

B. Sc VIth Semester

CORE COURSE XIII

DEVELOPMENTAL BIOLOGY

THEORY **(CREDITS 4)**

Unit I: Introduction **4**

1. Historical perspective and basic concepts: Phases of development.
2. Cell-Cell interaction, Pattern formation.
3. Differentiation and growth.
4. Differential gene expression.
5. Cytoplasmic determinants and a symmetric cell division.

Unit II: Early Embryonic Development **28**

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

Unit III: Late Embryonic Development **8**

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

Unit IV: Post Embryonic Development **12**

14. Metamorphosis: Changes, hormonal regulations in amphibians and insects.
15. Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).
16. Ageing: Concepts and Theories.

Unit V: Implications of Developmental Biology **8**

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

DEVELOPMENTAL BIOLOGY

PRACTICALS **(CREDITS 2)**

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. 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)
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture
4. Study of different sections of placenta (photo micropgraph /slides)
5. Project report on *Drosophila* culture/chick embryo development

SUGGESTED READINGS

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky., B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
- Carlson, R. F. Patten's Foundations of Embryology.
- Kalthoff. (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press.

CORE COURSE XIV

EVOLUTIONARY BIOLOGY

THEORY **(CREDITS 4)**

Unit I: **7**

1. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo Darwinism.
2. Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (Universality of genetic code and protein synthesizing machinery, three domains of life, neutral theory of molecular evaluation, molecular clock, example of globin gene family, rRNA/cyt-c **10**
3. Sources of variation: Heritable variations and their role in evaluation

Unit II: **13**

4. Population genetics: Hardy-Weinberg Law (Statement and derivation of equation, application of law to human Population)
5. Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load
6. mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection.
7. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies **7**

Unit III:

8. Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms
9. modes of speciation—allopatric, sympatric
10. Adaptive radiation / macroevolution (exemplified by Galapagos finches

Unit IV: **6**

11. Origin and evolution of man
12. Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*
13. molecular analysis of human origin

Unit V:

14. Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees **2**

EVOLUTIONARY BIOLOGY

PRACTICALS **(CREDITS 2)**

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. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphicalrepresentationandinterpretationofdataofheight/weightofasample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

SUGGESTED READINGS

- Ridley,M (2004) Evolution III Edition Blackwellpublishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
- Campbell,N.A.andReeceJ.B(2011).Biology.IXEdition.Pearson,Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. SinauerAssociates.
- Snustad. S Principles ofGenetics.
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley- Blackwell

DSE - 3

BASICS OF NEUROSCIENCE

THEORY **(Credits 4)**

Unit I: Introduction to Neuroscience **6**

Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology

Unit II: The Nervous system- An Introduction **14**

Introduction to the structure and function of the nervous system: Cellular components: Neurons; Neuroglia; Neurondoctrine; Theprototypical neuron

– axonsand dendritesas unique structural components of neurons. Theionic bases of resting membrane potential; Theaction potential-its generation and properties; The action potential conduction.

Unit III: Cellular and Molecular Neurobiology **14**

Molecular and cellular approaches used to study the CNS at the level of single molecules, Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ionchannels, Neural transmission,

Unit IV.Neurotransmitters **10**

Different types of neurotranmitters– catecholamines, amino acidergic and peptidergic neuro transmitters;Transmittergated channels; G-proteincoupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

Unit V: Neurobiology and Neuropharmacology of Behaviour **16**

The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems, molecular basis of behavior including learning and memory. Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson's, Alzheimer's, psychological disorders, addiction,etc.

BASICS OF NEUROSCIENCE

PRACTICAL **(CREDITS 2)**

Basics of neuroscience.

1. Dissection and study of nervous system of invertebrates (Earthwom, Cockroach, Prawn/Sepia) and vertebrates (Fish and rat).
2. Study of neurons by Nissl's staining.
3. Study of exploratory behavior in rats.
4. Study of learning behavior in rats by T maze and Y maze.
5. Study of neurobehavioral reflexes in newborn pups.
6. Study of electron micrograph and histological slides of nervous system.
7. Anatomical study of various parts of central nervous system.
8. Study of olfaction in *Drosophila.*

SUGGESTED READINGS

- Neuroscience:ExploringthebrainbyMarkF.Baer;BarryW.Connors.2015
- FromMoleculestoNetworks:AnIntroductiontoCellularandMolecular NeurosciencebyJohnH.Byrne.RuthHeidelbergandM.NealWaxham
- Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates,Inc.-2004
- PrinciplesofNeuralScience-4thEdn-Eds.Kandel,SchwartzandJessell-McGraw- HillCompanies-2000
- Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young- CUP-2003
- Essential Psychopharamacology- Neuroscientific Basis and Practical Applications- 2nd Edn.-Stephan M.Stahl-CUP-2000
- PhantomsintheBrain-VilayanurS.RamachandranandSandraBlakeslee-1998
- The Human Brain Book - RitaCarter-2009

DSE 4

WILD LIFE CONSERVATION AND MANAGEMENT

THEORY **(CREDITS 4)**

Unit 1: Introduction to Wild Life: Evaluation and management of wild life

Values of wildlife-positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

Unit 2: Management of habitats

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

Unit 3: Population estimation

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Fecal analysis of ungulates and carnivores: fecal samples, slide preparation, Hair identification, Pug marks and census method.

Unit 4: Management planning of wild life in protected areas

Estimation of carrying capacity; Ecotourism/wildlife tourism in forests; Concept of climax persistence; Ecology of perturbence.

Unit 5: Management of excess population and Protected areas

Bio-telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger Conservation-Tiger reserves in India; Management challenges in Tiger reserve.

WILD LIFE CONSERVATION AND MANAGEMENT

PRACTICALS **(CREDITS 2)**

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna in wild
2. Demonstration of basic equipment needed in wild life studies, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses, etc.)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ, Tentree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail/transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

SUGGESTED READINGS

- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management.* Blackwell Science.

- WoodroffeR., Thirgood,S.and Rabinowitz,A.(2005). *PeopleandWildlife,Conflict or Co-existence*? Cambridge University.

- Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats,* 5 th edition. The Wildlife Society, AllenPress.

- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Black well Sciences

- Hunter M. L., Gibbs,J.B. and Sterling, E.J.(2008).*Problem-Solvingin Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Black well Publishing.