

JIWAJI UNIVERSITY, GWALIOR
B. Sc. (Hons) Zoology Syllabus Choice Based Credit System
Structure for Undergraduate Program Session 2022-2026

Semester	Subject										Total Credits
	Major Core Course Theory (4-Credits)	Major DSE Theory (4-Credits)	Minor Theory (4-Credits)	Any other faculty Generic Elective (GE) Theory (4-Credits)	Vocational (SEC) Theory (4-Credits)	Ability Enhancement (AEC) (4-Credits)	Subject		Field Project/ Internship (6/10 Credits)		
I	101	--	102	GE-1	103	104	105	106	--	20	
	Non-chordates I: Protista to Pseudocoelomates		Principles of Ecology	Plant Ecology and Taxonomy		English Communication	Non-chordates I: Protista to Pseudocoelomates	Principles of Ecology			
II	201	--	202	GE-2	203	204	205	206	--	20	
	Non-chordates II: Coelomates		Cell Biology	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	Environmental Science	Non-chordates II: Coelomates	Cell Biology				
III	301	--	302	GE-3	303	--	304	305	--	20	
	Diversity of Chordates		Fundamentals of Biochemistry	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	Apiculture	Diversity of Chordates	Fundamentals of Biochemistry				
IV	401	--	402	GE-4	403	--	404	405	--	20	
	Comparative Anatomy of Vertebrates		Animal Physiology: Controlling and Coordinating Systems	Chemical Energetics, Equilibria & Functional Organic Chemistry	Medical Diagnostics	Comparative Anatomy of Vertebrates	Animal Physiology: Controlling and Coordinating Systems				
V	501	502	--	503	--	--	504	--	505	20	
	Animal Physiology: Life Sustaining Systems	Biochemistry of Metabolic Processes			Basics of Aquaculture	Animal Physiology: Life Sustaining Systems And Biochemistry of Metabolic Processes			FP-1 (6- credits)		
VI	601	602	603	--	--	--	604	--	605	20	
	Molecular Biology	Principles of Genetics	Evolutionary Biology			Molecular Biology, Principles of Genetics and Evolutionary Biology Lab			FP-2 (6- credits)		
VII	701	702	703	--	--	--	704	--	705	20	
	Developmental Biology	Fish and Fisheries	Research Methodology			Developmental Biology and Fish and Fisheries			FP/RP (6- credits)		
VIII	801	--	802	--	--	--	803	--	804	20	
	Basics of Neuroscience		Wildlife Conservation and Management			Basics of Neuroscience and Wildlife Conservation and Management			FP/RP (10- credits)		
Total	32	16	24	12	16	8	16	8	28	160	

Jiwaji University, Gwalior
B.Sc. (Hons) Zoology 2022-26
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
101-T (Major Course)	Non-chordates I: Protista to Pseudocoelomates	100	4	60	21	40	14
102-T (Minor Course)	Principles of Ecology	100	4	60	21	40	14
105- Lab (Major Course)	Non-chordates I: Protista to Pseudocoelomates Lab	100	2	60	21	40	14
106- Lab (Minor Course)	Principles of Ecology Lab	100	2	60	21	40	14
GE-I-T	Plant Ecology and Taxonomy	100	4	60	21	40	14
AEC-I-104-T	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
201-T (Major Course)	Non-chordates II: Coelomates	100	4	60	21	40	14
202-T (Minor Course)	Cell Biology	100	4	60	21	40	14
205-Lab (Major Course)	Non-chordates II: Coelomates Lab	100	2	60	21	40	14
206- Lab (Minor Course)	Cell Biology Lab	100	2	60	21	40	14
GE-II-T	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	100	4	60	21	40	14
AEC-II-204-T	Environmental Science	100	4	60	21	40	14
	Grand Total		20				

Third Semester		Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
Course Code	Course Name			MAX	MIN	MAX	MIN
							14
301-T (Major Course)	Diversity of Chordates	100	4	60	21	40	14
302-T (Minor Course)	Fundamentals of Biochemistry	100	4	60	21	40	14
304-Lab (Major Course)	Diversity of Chordates Lab	100	2	60	21	40	14
305-Lab (Minor Course)	Fundamentals of Biochemistry Lab	100	2	60	21	40	14
GE-III-T	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	100	4	60	21	40	14
SEC-I-303-T	Apiculture	100	4	60	21	40	14
	Grand Total		20				

Fourth Semester

Fourth Semester		Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
Course Code	Course Name			MAX	MIN	MAX	MIN
							14
401-T (Major Course)	Comparative Anatomy of Vertebrates	100	4	60	21	40	14
402-T (Minor Course)	Animal Physiology: Controlling and Coordinating Systems	100	4	60	21	40	14
404-Lab (Major Course)	Comparative Anatomy of Vertebrates Lab	100	2	60	21	40	14
405-Lab (Minor Course)	Animal Physiology: Controlling and Coordinating Systems Lab	100	2	60	21	40	14
GE-IV-T	Chemical Energetics, Equilibria & Functional Organic Chemistry	100	4	60	21	40	14
SEC-II-403-T	Medical Diagnostics	100	4	60	21	40	14
	Grand Total		20				

Semester		Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
Course Code	MAX				MIN	MAX	MIN	
501-T (Major Course)	Animal Physiology: Life Sustaining Systems	100	4	60	21	40	14	
DSE-I-502-T	Biochemistry of Metabolic Processes	100	4	60	21	40	14	
504-Lab (Major Course)	Animal Physiology: Life Sustaining Systems and Biochemistry of Metabolic Processes Lab	100	2	60	21	40	14	
SEC-III-503-T	Basics of Aquaculture	100	4	60	21	40	14	
FP-I-505	Field Project/Internship	100	6	60	21	40	14	
Grand Total			20					

Sixth Semester		Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
Course Code	MAX				MIN	MAX	MIN	
601-T (Major Course)	Molecular Biology	100	4	60	21	40	14	
DSE-II-602-T	Principles of Genetics	100	4	60	21	40	14	
DSE-III-603-T	Evolutionary Biology	100	4	60	21	40	14	
604-Lab (Major Course)	Molecular Biology, Principles of Genetics and Evolutionary Biology Lab	100	2	60	21	40	14	
FP-II-605	Field Project/Internship	100	6	60	21	40	14	
Grand Total			20					

Seventh Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
701-T (Major Course)	Developmental Biology	100	4	60	21	40	14
DSE-IV-702-T	Fish and Fisheries	100	4	60	21	40	14
703-T (Minor Course)	Research Methodology	100	4	60	21	40	14
704-Lab (Major Course)	Developmental Biology and Fish and Fisheries Lab	100	2	60	21	40	14
FP/RP-705	Field Project/Internship	100	6	60	21	40	14
	Grand Total		20				

Eighth Semester

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
801-T (Major Course)	Basics of Neuroscience	100	4	60	21	40	14
802-T (Minor Course)	Wildlife Conservation and Management	100	4	60	21	40	14
803-Lab (Major Course)	Basics of Neuroscience and Wildlife Conservation & Management Lab	100	2	60	21	40	14
FP/RP-804	Field Project/Internship	100	10	60	21	40	14
	Grand Total		20				

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

FIRST SEMESTER

101- THEORY (MAJOR COURSE)

NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES

THEORY

(Credits-4)

Unit I: Protista, Parazoa and Metazoa

19

1. General characteristics and Classification upto 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 upto 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 upto 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 of 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 Nematelminthes

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"



102- THEORY (MINOR COURSE)
PRINCIPLES OF ECOLOGY

(Credits-4)

6

THEORY

Unit I: Introduction to Ecology

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

24

Unit II: Population

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.

12

Unit III: Community

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 one example of Nitrogen cycle.
19. Zoo-geographical region of wildlife distribution.

105- LAB (MAJOR COURSE)

NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES

PRACTICAL

(Credits-2)

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 life cycles/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.



**106- LAB (MINOR COURSE)
PRINCIPLES OF ECOLOGY**

(Credits 2)

PRACTICALS

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/Wildlife sanctuary.

SUGGESTED READINGS

1. Colinvax, 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.



GENERIC ELECTIVE: GE-1 THEORY
PLANT ECOLOGY AND TAXONOMY

THEORY

Unit I: Introduction, Ecological factors and Plant communities (Credits-4)
(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.

Unit 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).



**AEC-1-104-THEORY
ENGLISH COMMUNICATION**

(Credits-4)

THEORY

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



SECOND SEMESTER
201-THEORY (MAJOR COURSE)
NON-CHORDATES II: COELOMATES

THEORY

(Credits-4)

Unit I: Introduction to Coelomates

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

2

10

Unit II: Annelida

5. General characteristics and Classification upto 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 upto 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

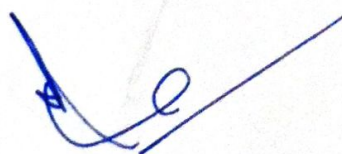
15. General characteristics and Classification upto classes
16. Respiration in Mollusca.
17. Torsion and detorsion in Gastropoda, Pearl formation in bivalves.
18. Larval forms of Mollusca.
19. Nervous system of *Pila*.

12

Unit V: Echinodermata

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

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



202- THEORY (MINOR COURSE)

CELL BIOLOGY

(Credits-4)

THEORY

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 endomembrane 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.

205-LAB (MAJOR COURSE)
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, mollusca 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.



206- LAB (MINOR COURSE)
CELL BIOLOGY

(Credits-2)

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 blood cells/cheek cells.
4. Cell viability assay
5. Preparation of blood smear to study types blood cells
6. Electron micrograph of various cell organelles
7. Study of permanent cytological slides

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., Kleinsmith, 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.



GENERIC ELECTIVE GE-2

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

THEORY

(Credits-4)

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)

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

Unit 3: Fungi (12 lectures)

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

Unit 4: Introduction to Archegoniate and Bryophytes

(12)

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

Unit 5: Pteridophytes and Gymnosperms

(14)

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

**AEC-II-204-THEORY
ENVIRONMENTAL SCIENCE**

(Credits-4)

THEORY

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 (ponds, 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 mega biodiversity 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 & Datta A.K. 1987. Waste Water Treatment, Oxford and IBH Publishing Co. Pvt. Ltd.
 3. Raven, P.H Hassenzuhl, D.M. & Berg L.R, 2012 Environment. 8th Edition. John Wiley & Sons.
 4. Singh, J.S. Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
 5. Agarwal, K.C. 2001 Environmental Biology, Nidi Publication. Ltd. Bikaner.
 6. Bharucha Erach, 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 & Bhosale V.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.
- JU B.Sc. Honors Zoology (2022-26)

T. K. 2010. Ecology and Environmental Biology, Books and Allied (P) Ltd. Kolkata.
S.C. 2005. Environmental Science, New Central Book Agency (P) Ltd. Kolkata.



THIRD SEMESTER
301-THEORY (MAJOR COURSE)
DIVERSITY OF CHORDATES

(Credits-4)

THEORY

8

Unit I: Protochordata

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.

2

Unit II: Agnatha, Pisces and Amphibia

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.

7

Unit III: Reptilia

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

8

Unit IV: Aves

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.

8

Unit V: Mammals

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.

302-THEORY (MINOR COURSE)
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).

304-LAB (MAJOR COURSE)
DIVERSITY OF CHORDATES

(Credits-2)

PRACTICAL

1. Protochordata

Balanoglossus, *Herdmania*, *Branchiostoma*, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchiogenital 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 per mission).
- Power point presentation on study of any two animals from two different classes by students (maybe 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). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

305-LAB (MINOR COURSE)
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.



GENERIC ELECTIVE-3: CHEMISTRY-I (THEORY)
ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

CREDITS-4

THEORY

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, sp², sp³), calculation of co-efficient of A.O.'s used in these hybrid orbitals. Schrödinger wave equation, Significance of ψ and ψ^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 behavior.
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 NH₃, H₃O⁺ and H₂O. 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 polarizability 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 pi bonds: Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions.
16. Reactions of alkenes: Electrophilic additions their mechanisms (Markownik off/ Anti Markownik off 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.



**SKILL ENHANCEMENT COURSES
SEC-1-303-THEORY**

APICULTURE

THRORY

(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.



FOURTH SEMESTER

401- THEORY (MAJOR COURSE)

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.

8

Unit II: Digestive System and Respiratory System

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

8

Unit III: Circulatory System

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

6

Unit IV: Urinogenital System

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

8

Unit V: Nervous System and Sense Organs

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.

402- THEORY (MINOR COURSE)
ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

Credits-4)

THEORY

6

Unit I: Tissues

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

4

Unit II: Bone, Cartilage and Muscle

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

10

Unit III: Nervous System

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.

10

Unit IV: Reproductive System

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

18

Unit V: Endocrine System

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.

404-LAB (MAJOR COURSE)
COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL

(CREDITS-2)

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Disarticulated skeleton 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 urino genital 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.
- Hilderbrand, 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.



405-LAB (MINOR COURSE)

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

(Credits-2)

PRACTICALS

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. Hercourt 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.

**GENERIC ELECTIVE-4:
CHEMISTRY-II (THEORY)**
CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY
THEORY **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 ΔG° , Le Chatelier's principle.
6. Relationships between K_p , K_c and K_x 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 (S_N1 , S_N2 and S_Ni) reactions. Preparation: from alkenes and alcohols.
15. Reactions: hydrolysis, nitrite & nitro formation, nitrile & iso nitrile 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: KNH_2/NH_3 (or $NaNH_2/NH_3$).
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. $KMnO_4$, acidic dichromate, conc. HNO_3).

19. Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, halogenation and sulphonation. Reimer-Baumann Reaction. Ethers (aliphatic and aromatic): Cleavage of ethers with HI.
20. Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, 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. & Snyder, 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).

SEC-II-403 THEORY
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.



FIFTH SEMESTER
501-THEORY (MAJOR COURSE)
ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

(Credits-4)

THEORY

- 14**
- Unit I: Physiology of Digestion**
1. Structural organization and functions of gastrointestinal 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.
- 12**
- Unit II: Physiology of Respiration**
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.
- 8**
- Unit III: Renal Physiology**
8. Structure of kidney and its functional unit.
 9. Mechanism of urine formation.
 10. Regulation of water balance.
 11. Regulation of acid-base balance.
- 14**
- Unit IV: Blood**
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.
- 12**
- Unit V: Physiology of Heart**
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.

DSE-I-502-THEORY
BIOCHEMISTRY OF METABOLIC PROCESSES

THEORY

- | | |
|--|---------------------------------|
| Unit 1: Overview of Metabolism | (CREDITS-4)
10 |
| <ol style="list-style-type: none">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 |
| <ol style="list-style-type: none">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 |
| <ol style="list-style-type: none">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 |
| <ol style="list-style-type: none">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 |
| <ol style="list-style-type: none">16. Redox systems: Review of mitochondrial respiratory chain.17. Inhibitors and un-couplers of Electron Transport System. | |



504-LAB (MAJOR COURSE)
ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS AND BIOCHEMISTRY OF METABOLIC PROCESSES

(CREDITS-2)

PRACTICALS

1. Determination of ABO Blood groups.
2. Enumeration of red blood cells and white blood cells using hemocytometer.
3. Estimation of hemoglobin using Sahli's haemoglobinometer.
4. Preparation of haemin and haemochromogen crystals.
5. Recording of blood pressure using sphygmomanometer.
6. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.
7. Estimation of total protein in given solutions by Lowry's method.
8. Detection of SGOT in serum/tissue
9. Detection of SGPT or GST and GSH in serum/tissue
10. To perform the Acid and Alkaline phosphatase assay from serum/tissue.
11. Detection of glucose by GOD-POD method (Kit)

(*Subject to UGC guidelines)

SUGGESTED READINGS

- Guyton, A.C.& Hall, J.E. (2006). Text book of Medical Physiology. XI Edition. Harcourt 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.
- 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.
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**SEC III-503-TEHORY
BASICS OF AQUACULTURE**

TEHORY

(Credit-4)

UNIT I:

1. Aquaculture: definition and scope and history of aquaculture, global and national scenario
2. Aquaculture versus agriculture
3. Systems of aquaculture: pond culture, cage culture pen culture
4. Extensive, intensive and semi-intensive aquaculture

UNIT II:

5. Prawn culture: fresh water and marine water
6. Fresh water aquaculture resources: pond, tanks, lakes, river and reservoir
7. Cultivable species of fish: major carps, minor carps, exotic carps and air breathing fish
8. Criteria for selection of fish species for aquaculture
9. Identification of and Classification of fish species used for aquaculture

UNIT III:

10. Breeding habits of cultivable species: growth and fecundity
11. Physical factors affecting fish culture: depth, temperature, light, turbidity and transparency
12. Chemical factors influencing fish culture: dissolved oxygen, carbondioxide, pH, hardness of water, alkalinity, dissolved inorganic and organic compounds
13. Biota of pond water: phytoplankton, zooplankton, crustaceans' larvae and insects' larvae

UNIT IV:

14. Carrying capacity of pond and layout of fish farm
15. Types of pond culture: hatching pits, spawning pond, nursery pond, rearing pond, growing pond and stocking pond
16. Fish seed requirement: fish seed collection, collection of eggs, spawn and method of operation
17. Transport of fingerlings and brood fish

UNIT V:

18. Bundh breeding of fish and Fertilization of fish by stripping
19. Induced breeding of carps: hypophysation Collection, preservation of gland, selection of breeders, preparation of injection and dosages and use of natural and synthetic hormones
20. Environmental and hormonal control of reproduction

FP-I-505

FIELD PROJECT/INTERNSHIP

(CREDITS-6)



SIXTH SEMESTER
601-THEORY (MAJOR COURSE)

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 *rpop* 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.



DSE-II-602-TEHORY
PRINCIPLES OF GENETICS

(CREDITS-4)

8

THEORY

Unit I: Mendelian Genetics and its Extension

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.

DSE-III-603-THEORY
EVOLUTIONARY BIOLOGY

THEORY

Unit I:

(CREDITS-4)

1. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo Darwinism. 7
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 evolution, molecular clock, example of globin gene family, rRNA/ cyt-c 10
3. Sources of variation: Heritable variations and their role in evolution 7

Unit II:

4. Population genetics: Hardy-Weinberg Law (Statement and derivation of equation, application of law to human Population) 13
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
7. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies

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:

11. Origin and evolution of man 6
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



604-LAB (MAJOR COURSE)
MOLECULAR BIOLOGY, PRINCIPLES OF GENETICS AND EVOLUTIONARY 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. Preparation of solid culture medium (LB) and growth of *E.coli* by spreading and streaking.
4. Study and interpretation of electron micrographs/ photograph showing
 - (a) DNA replication
 - (b) Transcription
 - (c) Split genes
5. To study the Mendelian laws and gene interactions.
6. Chi-square analyses using seeds/beads/*Drosophila*.
7. Linkage maps based on data from conjugation, transformation and transduction.
8. Linkage maps based on data from *Drosophila* crosses.
9. Study of human karyotype (normal and abnormal).
10. Pedigree analysis of some human inherited traits.
11. Field collection and laboratory culture of *Drosophila*.
12. Study of male, female and somatic mutant phenotypes in *Drosophila*.
13. Study of fossils from models/pictures
14. Study of homology and analogy from suitable specimens

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. G S, Taylor and Francis Group, New York and London.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. WileyIndia.
- 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.
 - Ridley, M (2004) *Evolution* III Edition Blackwell publishing
 - Hall, B.K. and Hallgrimson, B (2008). *Evolution* IV Edition. Jones and Barlett Publishers.
 - Campbell, N.A. and Reece J. B (2011). *Biology*. IX Edition. Pearson, Benjamin, Cummings.
 - Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
 - Snustad. S Principles of Genetics.
 - Pevsner, J (2009). *Bioinformatics and Functional Genomics*. II Edition Wiley- Blackwell



FP-II-605

FIELD PROJECT/INTERNSHIP

(CREDITS)



SEVENTH SEMESTER
701-THEORY (MAJOR COURSE)
DEVELOPMENTAL BIOLOGY

THEORY

Unit I: Introduction

(CREDITS-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 asymmetric cell division.

4

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 Blastulas, 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

**DSE-IV-702-THEORY
FISH AND FISHERIES**

(Credits-4)

THEORY

- 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; Bioluminescence; 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
- Unit 4: Aquaculture** **20**
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; 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



**703-T (MINOR COURSE)
RESEARCH METHODOLOGY**

THEORY

(Credits-4)

UNIT-I: Introduction to research:

1. What is research?
2. Significance of research
3. Research and scientific methods.
4. Definition of a research problem:
5. What is a research problem? How to select and define a research problem?

UNIT-II: Research design:

6. Meaning, need, features and types of a research design
7. Basic principles of research design
8. Hypothesis:
9. What is a hypothesis?
10. Basic concepts related to testing a hypothesis

UNIT-III: Basic statistics:

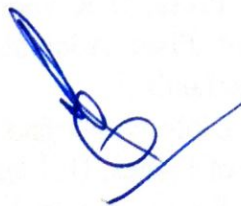
11. Methods of data collection
12. Collection of primary and secondary data
13. Measure of central tendency
14. Measures of dispersion
15. Measures of asymmetry
16. Measures of relationship
17. Simple regression analysis
18. Multiple correlation and regression

UNIT-IV: Scientific writing:

19. Introduction to types of scientific documentation
20. Abstract, research paper, review, commentary, project report and thesis
21. Mechanics of scientific report writing
22. The language of science

UNIT-V: Presentation:

23. Document layout and editing
24. Excel: Tabulation and graphical presentation
25. PowerPoint Presentation
26. Computers in research: Introduction



704-LAB (MAJOR COURSE)
DEVELOPMENTAL BIOLOGY AND FISH AND FISHERIES

(CREDITS-2)

PRACTICALS

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 (photomicrograph/slides)
5. Project report on *Drosophila* culture/chick embryo development
6. Morphometric and meristic characters of fishes
7. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
8. Study of different types of scales (through permanent slides/photographs).
9. Study of crafts and gears used in Fisheries
10. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
11. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
12. Demonstration of induced breeding in Fishes (video)
13. Demonstration of parental care in fishes (video)
14. Project Report on a visit to any fish farm/pisciculture unit/Zebra fish rearing Lab.

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.
- Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U. K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, C R C Press, U K vonder Emde, R. J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

FP/RP-705
FIELD PROJECT/INTERNSHIP

(CREDITS-6)



EIGHTH SEMESTER
801-THEORY (MAJOR COURSE)
BASICS OF NEUROSCIENCE

	(Credits-4)
THEORY	6
Unit I: Introduction to Neuroscience	
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; Neuron doctrine; The prototypical neuron Axons and dendrites as unique structural components of neurons. The ionic bases of resting membrane potential; The action 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. Ion channels, Neural transmission,	
Unit IV: Neurotransmitters	10
Different types of neurotransmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.	
Unit V: Neurobiology and Neuropharmacology of Behavior	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.	

**802-THEORY (MINOR COURSE) THEORY
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 perturbation.

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.

803-LAB (MAJOR COURSE)
BASICS OF NEUROSCIENCE AND WILDLIFE CONSERVATION & MANAGEMENT

PRACTICAL

(CREDITS-2)

Basics of neuroscience.

1. Dissection and study of nervous system of invertebrates (Earthworm, Cockroach, Prawn/Sepia) and vertebrates (Fish and rat).
2. Study of exploratory behavior in rats.
3. Study of learning behavior in rats by T maze and Y maze.
4. Study of electron micrograph and histological slides of nervous system.
5. Anatomical study of various parts of central nervous system.
6. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna in wild
7. Demonstration of basic equipment needed in wildlife studies, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses, etc.)
8. Familiarization and study of animal evidences in the field; Identification of animals through pugmarks, hoofmarks, scats, pellet groups, nest, antlers, etc.
9. Demonstration of different field techniques for flora and fauna
10. Trail/transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

SUGGESTED READINGS

- Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015
- From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham
- Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004
- Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell-McGraw-Hill Companies-2000
- Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young- CUP-2003
- Essential Psychopharmacology- Neuroscientific Basis and Practical Applications- 2nd Edn.-Stephan M. Stahl-CUP-2000
- Phantoms in the Brain-Vilayanur S. Ramachandran and Sandra Blakeslee-1998
- The Human Brain Book - Rita Carter-2009
- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
- Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence?* Cambridge University.
- Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5th edition. The Wildlife Society, Allen Press.
- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences

FP/RP-804
FIELD PROJECT/INTERNSHIP

(CREDITS-10)



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