



RANI CHANNAMMA UNIVERSITY,

Vidyasangama, PB-NH-4, Bhutaramanahatti,

BELAGAVI – 591 156

SCHOOL OF BASIC SCIENCES

Department of Studies in Zoology

M.Sc., Zoology Course

(CBCS)

STRUCTURE AND SYLLABUS

With effect from 2020-21

RANI CHANNAMMA UNIVERSITY, BELAGAVI
DEPARTMENT OF ZOOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS)
COURSE STRUCTURE AND SCHEME OF EXAMINATION

Sem.	Course No.	Title of the course	Credits	Teaching hours/week	Maximum Marks		
					Written exam	I.A.	Total
I		Compulsory Courses:					
	1.1	Animal systematics and Evolution	4	4	80	20	100
	1.2	Biology of Non-chordates	4	4	80	20	100
	1.3	Biology of Chordates	4	4	80	20	100
	1.4	Environmental Biology	4	4	80	20	100
	1.5	Practical – I Based on 1.1	2	4	40	10	50
	1.6	Practical – II Based on 1.2	2	4	40	10	50
	1.7	Practical – III Based on 1.3	2	4	40	10	50
	1.8	Practical – IV Based on 1.4	2	4	40	10	50
II		Compulsory Courses:					
	2.1	Molecular Genetics	4	4	80	20	100
	2.2	Molecular Cell Biology	4	4	80	20	100
	2.3	Animal Physiology	4	4	80	20	100
		Open Elective Course:					
	2.4	Economic Zoology	4	4	80	20	100
		Compulsory Courses:					
	2.5	Practical – V Based on 2.1	2	4	40	10	50
	2.6	Practical – VI Based on 2.2	2	4	40	10	50
2.7	Practical – VII Based on 2.3	2	4	40	10	50	

SEMESTER I:

Compulsory papers

Theory	Hrs/Wk	Credits	Practical	Hrs/Wk	Credits
ZCT-1.1 Animal Systematics and Evolution	4	4	ZCP 1.5	4	2
ZCT-1.2 Biology of non-chordates	4	4	ZCP 1.6	4	2
ZCT-1.3 Biology of chordates	4	4	ZCP 1.7	4	2
ZCT-1.4 Environmental Biology	4	4	ZCP 1.8	4	2
		16	+	8 = 24	

SEMESTER II:

Compulsory papers

Theory	Hrs/Wk	Credits	Practical	Hrs/Wk	Credits
ZCT-2.1 Molecular Genetics	4	4	ZCP 2.6	4	2
ZCT-2.2 Molecular Cell Biology	4	4	ZCP 2.7	4	2
ZCT-2.3 Animal Physiology	4	4	ZCP 2.8	4	2
		12	+	6 = 18	

M.Sc., ZOOLOGY SYLLABUS

SEMESTER I

PAPER ZCT-1.1 ANIMAL SYSTEMATICS AND EVOLUTION

Teaching Hours per Week: 4

No. of Credits: 4

Unit I: Science of Biosystematics and Species concept (7)

Concept of Biosystematics, Terms used in systematic biology, Historical review of taxonomic philosophies, Future of taxonomic studies, Stages in taxonomy, Tasks of taxonomist, Systematics as a profession

Historical perspectives of species concept (typological, nominalist, biological), kinds of species- sibling, sympatric, allopatric, syntopic, ring species, polytypic and monotypic species. Intraspecific groups (variety, morphs, subspecies, temporal subspecies, race and clines)

Unit II: Taxonomic Collection, Preservation and Identification (7)

Collection - Purpose, value, scope of collection, content of collection, significance of museum collections, legal aspects of collecting animals, post collection processes. Preparation and packaging of specimen for posting.

Preservation - Methods, taxidermy, plastination, factors responsible for the deterioration of museum specimens. Curating of collections - museum collection policy, preparation of material for study, housing and cataloging

Identification - Systematic process of sorting and labelling, procedure of identification; identification services.

Unit III: Classification and Phylogenetic Analysis (8)

Components of classification; Procedure of classification (phenetic and cladistic), presentation of classification - Linnaean/Taxonomic hierarchy, ways of constructing a phylogenetic tree. Phylogenetic analysis - Purpose, terminology, methods of phylogenetic analysis (Phenetic method, dendrogram method, pairwise distance; Cladistics method, parsimony, maximum likelihood); phylogenetic lineages

Unit IV: Application of Zoological Nomenclature (8)

Taxonomic keys and their significance, International rules of nomenclature – International Code of Zoological Nomenclature (ICZN); DNA bar coding, the taxonomic bottle neck, digitization of taxonomic data/ Bioinformatics.

Unit V: Introduction to evolution and Theories of evolution (10)

Evolution of evolutionary thoughts, Lamarckism; Natural Selection (Darwinism), Contributions of Charles Darwin, Alfred Russel Wallace, Thomas Malthus and Hugo de Vries; Postulates of Natural Selection and evidences; Natural Selection in action- Industrial melanism; Darwin's finches, Experimental evidences of Natural selection- Endler's guppies ; Concepts of inclusive fitness – altruism and kin selection.

Unit VI: Neo-Darwinism and Non-Darwinism (10)

Neo-Darwinism: Hardy-Weinberg Law of genetic equilibrium; Genes and genotype frequencies, Concept of Mendelian Population and gene pool; Factors operating against Hardy-Weinberg Law; Selection - types of selection- balancing selection, frequency dependent selection, directional selection, disruptive selection, artificial selection; Random Genetic drift (Bottle neck effect, Founder's effect); Migration.

Non-Darwinism: Molecular polymorphism: Nucleic acids and proteins; Molecular clock; Neutral theory of evolution and evolution random walk; Forces in evolution- stochastic vs deterministic.

PRATICALS FOR ZCP: 1.5- ANIMAL SYSTEMATICS AND EVOLUTIONARY BIOLOGY

1. Biosystematic position of specimens:
 - a. Phylum Protozoa to Phylum Echinodermata
 - b. Cyclostomata to Mammals
2. Morphometric measurements of some locally available fishes
3. Construction of different types of Taxonomic key for the identification of animals
4. Construction of phylogenetic trees by taking suitable examples
5. Evidence for Principle of Evolution:
 - a. Homologous structures
 - b. Serial homology
6. Evidence for Principle of Evolution:
 - a. Analogous organs
 - b. Vestigial organs
7. Embryological evidence for evolution: Descent with modification.
8. Fossils and Living fossils.
9. Application of Hardy-Weinberg principle to determine allelic frequency of:
 - a. PTC trait in man
 - b. blood group trait in man
10. Any other practical depending on feasibility.

Reference Books:

- 1) Batschelet, E. (1975) Introduction to Mathematics for Life Scientists, 2nd edition,

Springer-Verlag, Berlin-Heidelberg-New York

- 2) Koto, M. (2000) The Biology of biodiversity, 1st edition, Springer, Japan.
- 3) Murry J.D. (1993) Mathematical Biology, 2nd edition, Springer-Verlag, New York/Berlin.
- 4) Snecdor, G.W. and Cochran W.G. (1989) Statistical Methods , Affiliated-East-West Press, New Delhi.
- 5) Sokal, R.R. and Rohlf F. J.(1995) Biometry the principles and practice of statistics in biological research, 3rd edition, New York W.H. Freeman.
- 6) Wilson, E.O. (1988) Biodiversity, National Academy Press, Washington, D.C.
- 7) Ernest Mayr. Principles of Systematic Zoology, Tata-McGraw-Hill, New Delhi, 1997.
- 8) Simpson, G.G. Principles of Animal taxonomy. Columbia University Press, New York, 1961.
- 9) Barnes, R.D. Invertebrates Zoology. IInd Saunders, Philadelphia,1968.
- 10) Kapoor, V.C. Theory of Animal Taxonomy, Oxford IBH Co. Pvt. Ltd., New Delhi, 1998.
- 11) Barrington, E.J.W. Invertebrates structure and Function, Nelson, London, 1967.
- 12) Hawksworth, D.L. (Ed). Biodiversity:Measurement and Estimation, Chapman and Hall, 1961.
- 13) Khan, T.I and Y.S. Shishodia. Biodiversity Conservation and Sustainable Development. Pointer Publications, Jaipur, 1998.
- 14) Futuyama, D.J. Evolutionary Biology- III Ed. Sinauer Associates Inc. Massachusetts, 1998.
- 15) Gerhart, J and Kirchner, M. Cell, Embryos & Evolution. Blackwell Science Publishers, 1997.
- 16) Keynes, R. Charles Darwin's Zoology Notes & Specimen List from H.M.S Beagle. Cambridge University Press, 2000.
- 17) Price, P.W. Biological Evolution. Saunders College Publishing, 1995.
- 18) Smith, J.M. Evolutionary Genetics. Oxford University Press
- 19) Dobzhansky, Th., F. J. Ayala, G. L. Stebbins and J. M. Balentine, (1976): Evolution. Surjeet Publication, Delhi.
- 20) Freeman, S and Herron J. C. (1998): Evolutionary Analysis. Prentice Hall, New Jersey.
- 21) Futuyama D. J. (1986): Evolutionary Biology. Sinauer Associates, INC. Sunderland.
- 22) Smith, J. M. (1998): Evolutionary Genetics. Oxford University Press. Oxford.
- 23) Stearns, S. C. and Hoekstra, R. F.(2000): Evolution: An Introduction.Oxford University Press. Oxford.
- 24) Strickberger, M. W. (1990): Evolution. Jones and Bartlett Publishers. Boston.
- 25) Strickberger., M. W. (2014): Evolution 5th edition. Jones and Bartlett Publishers. Boston.
- 26) Futuyama, D. J. (2013): Evolution. Macmillan education.

PAPER ZCT-1.2 BIOLOGY OF NON-CHORDATES

Teaching Hours per Week: 4
No. of Credits: 4

Unit I: Coelom, Body plan and Phylogeny (8)

Symmetry and evolution of bilateria; Evolution and significance of coelom; evolution and significance of metamerism; Protostomia and Deuterostomia

Phylogeny and systematic position of Ctenophora, Entoprocta, Sipunculida and Ectoprocta

Unit II: Locomotion and Nutrition (12)

Amoeboid, Ciliary and Flagellar movements in Protozoa; Ultrastructural aspects of flagella; Principle of hydrostatic skeleton; hydrostatic movement in Annelida; Flight movement in insects

Nutrition in Protozoa and lower Metazoan; Filter feeding in Polychaeta, Mollusca, Crustacea and Echinodermata; Feeding patterns in insects

Unit III: Respiration and Circulation (10)

Respiratory organs in invertebrates – gills, lungs and trachea; Respiratory pigments - hemoglobin, hemocyanin, hemerythrin and chlorocruorin

Circulation – Patterns (open and closed types) with suitable examples

Unit IV: Excretion (7)

Excretory organs – Flame cells, coelomoducts, nephridia and Malpighian tubules – Morphology and mechanisms of excretion

Unit V: Nervous System (7)

Trends in neural evolution: Primitive nervous system in Cnidaria and Echinodermata; Advanced nervous system in Annelida, Arthropoda and Mollusca; Brief review of sense organs in different phyla

Unit VI: Reproduction (6)

Asexual, sexual and parthenogenetic modes of reproduction and their significance; Larval forms and their significance

ZCP- 1.6: BIOLOGY OF NON-CHORDATES PRACTICALS

1. Observation of microorganisms in given water sample.
- 2-4. Study of Earthworm: a. Digestive system, b. Nervous system, c. Mounting of ovary, d. Mounting of setae, e. Mounting of Nephridia
- 5-6. Study of Starfish: a. Digestive system, b. Water vascular system, c. Mounting of tube feet
7. Study of organs of locomotion: a. Setae of earthworm, b. Tube feet of starfish, c. Leg of cockroach
8. Nutrition: a. Tubular feeding in Hydra, b. Eversible pharynx in Planaria, c. Filter feeding in Sponge, Terebella, Sabella and Unio
9. Respiratory organs: a. Branchial cone in Terebella, b. Ctenidia in Unio, c. Rectal gills in Naids, d. Tracheae in Cockroach
10. Excretion: a. Nephridium in earthworm, b. Malpighian tubules in cockroach
11. Reproduction: a. Conjugation in Paramecium, b. Ovary of earthworm
12. Invertebrate larvae: a. Coelenterate larva – Ephyra, b. Platyhelminthes larvae – Redia, Cercaria, Echinococcus, c. Annelida larva – Polychaete larva, d. Arthropod larvae – Nauplius, Mysis, Zoea, Phyllosoma, Mosquito larva, Megalopa, e. Mollusca larvae – Veliger, Glochidium, f. Echinoderm larvae – Bipinnaria, Brachiolaria, Pluteus
13. Any other practical depending on feasibility

Reference Books:

- 1) Barrington, E J W, (1976): Structure and Functions of Invertebrates.
- 2) Barnes, RD, Invertebrate Zoology, Halt Saunders Intl. Edition
- 3) Hyman ,L.H, The invertebrates (all volumes), McGraw Hill, Philadelphia, USA
- 4) Huston, AM, Biological Diversity, Cambridge University Press, Cambridge
- 5) Kapoor V.C, Theory and Practice of Animal Taxonomy, Oxford and IBH Publ., Delhi
- 6) McNeely ,JA, Economics and Biological Diversity, IUCN, Gland, Switzerland
- 7) Miller,S.A. and Harley,J.P. (2005). Zoology. 6th Ed.,McGraw Hill Higher Education,
- 8) Boston, Toronto,Sydney
- 9) Prasad S.N, Life of Invertebrates, Vikas Publ. New Delhi
- 10) Sinha, A.K, Adhikari S and Ganguly BB, Biology of Animals (vol. I & II),
- 11) Central Book Agency, Kolkata
- 12) Young ,J.Z. Life of Vertebrates, Clarendon Press, Oxford
- 13) Invertebrate Zoology ----- EL Jordan; P.S. Verma
- 14) A Text Book of Zoology Vol. I ----- P.S. Dhami; Jk.Dhami.
- 15) A Text Book of Invertbrate zoology ----- R.L.Kotpal.
- 16) Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.

PAPER ZCT- 1.3: BIOLOGY OF CHORDATES

Teaching Hours per Week: 4
No. of Credits: 4

UNIT I. Origin and interrelationships (13)

General characters and outlines of classification of Chordata - the construction and interpretation of classifications. Origin of chordates in the light of recent theories.

Fine structure and role of notochord and endostyle in Amphioxus and Ascidia with their evolutionary significance.

General characters and classification of Protochordata.. Phylogenetic relationship between Protochordates and Chordates

Reproduction in Tunicates and significance of retrogressive metamorphosis.

The Nature of Vertebrate Morphology – Definition, Scope and Relation to other disciplines; Importance of the study of vertebrate morphology.

Some principles and considerations. Origin and Classification of Vertebrates.

UNIT II. Vertebrate Integument, Excretory system, (6)

Development and general structure of skin and its functions; Integument of fishes with emphasis on dermal derivatives; Integument of Tetrapods with emphasis on epidermal derivatives - glands, scales, horns, claws, nails, hoofs, feathers and hairs.

Excretion- Evolution of uro-genital system in Vertebrates; Comparative account of kidney in Vertebrates

Unit III Nervous system and Sense organs (6)

Nervous system: Development of spinal cord and peripheral nervous system; Evolution of spinal nerves, cranial nerves and autonomic nervous system; Development and organization of the brain; Comparative account of brain in Vertebrates.

Sense organs: Types of receptors; Organs of olfaction and taste- Vomero-nasal/Jacobson's organ in reptiles; lateral line system; electroreception in fish; ear and eyes in Vertebrates.

UNIT IV. Respiration, circulation and locomotion: (7)

Structure and mechanism of cutaneous, branchial and pulmonary respirations.

Outline of origin and evolution of cardiovascular system in vertebrates.

Form, function, size and skeletal and muscular elements of the body –Appendicular skeleton – origin of tetrapod limbs and their modifications. Appendicular musculature of Tetrapodes.

Axial skeletons- Overview of Skull Morphology, Skull Function and Design.Origin of Jaw and modification of Jaw bones and types.Functional and evolutionary significance of Jaw suspension in Vertebrates. Origin and evolution of Webbarianossicles in fish and ear ossicles in mammals

UNIT V. Vertebrate

(6)

Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatins, Heterocoelus, Axis and atlas vertebrae

Types of Vertebrate musculature. Flight muscles of Birds; Skeletal and muscular elements in Running and jumping; Digging and crawling without appendages; Climbing; Swimming, diving, Flying and Gliding.

UNIT IV. Adaptive radiation in Vertebrates

(12)

Origin, evolution and adaptive radiation in fishes, amphibians, reptiles, birds and mammals

ZCP- 1.7 BIOLOGY OF CHORDATES PRACTICALS

1. Study of digestive system in Shark/Chick
2. Study of male reproductive system in Shark/Chick
3. Study of female reproductive system in Shark/Chick
4. Study of cranial nerves of Shark
5. Study of digestive system in Rat
6. Study of male reproductive system in Rat
7. Study of female reproductive system in Rat
8. Study of cranial nerves in Rat
9. Mounting: a. Membranous labyrinth of shark, b. Ampullae of Lorenzini of shark, c. Placoid scales of shark
10. 10. Mounting: a. Brain of shark, b. Brain of rat
11. Identification

Protochordates: Balanoglossus, Botryllus, Amphioxus, Doliolum, Ascidia, Petromyzon

Pisces: Myxine, Clarius, Echeuis (Sucker fish), Scoliodon, Hippocampus, Sting ray

Amphibians: Ichthyophis, Siren, Bufo, Axolotal larva, Ranatigrina, Ambystoma, Rhacophorus

Reptiles: Tortoise, Phrynosoma, Krait, Draco (flying lizard), Varanus, Russel's viper, Typhlops, Chameleon

Birds: Cuckoo (male and female), Brahminy kite, Gallus gallus (male and female), Indian roller, Horn bill, Owl

Mammals: Pangolin (Ant eater), Loris, Hystrix, Hedgehog, Flying squirrel

12. Any other practical depending on feasibility

References Books:

1. Barrington, E.J.W. (1965): The biology of Hemichordata and Protochordata. Oliver and Boyd, Edinburgh, UK.
2. Colbert, E.H. (2011) Evolution of the Vertebrates. 5th Edn. John Wiley and Sons Inc., New York
3. Hyman, L.H. (1966): Comparative Vertebrate Anatomy. The University of Chicago Press, Chicago
4. Milton Hildebrand and George Goslow (2002): Analysis of Vertebrate Structure, 5th Edn. John Wiley and Sons Inc., New York
5. Romer, A.S. Vertebrate Paleontology. 3rd Edn. University of Chicago Press, Chicago
6. Weichert, C.K. and Presch, W. Elements of Chordate anatomy. 4th Edn. McGraw Hill Book Co., New York.
7. Weichert, C.K., Anatomy of Chordates McGraw Hill Book Co. Inc. London.
8. Young, J.Z. (1981): The Life of Vertebrates, 3rd Edn. Clarendon Press Oxford.
9. Young, J.Z. (1976):, Life of mammals The Oxford University Press, London.
10. Barnes, R.S.K. (1993) The invertebrates: a new synthesis, Blackwell Scientific Publication.
11. Cleveland, H.P., Roberts, Larry S. (Jr) and Larson A. (1995) Integrated Principles of Zoology. 9th edition, WBC Brown publishers.
12. Gardiner, M. S. (1972) The Biology of Invertebrates, Mc. Graw Hill Book Co.
13. Hyman L. H. (2004) Anatomy of Comparative Vertebrates. Reprint. Satish Serial Publishing, Delhi.
14. Kenneth, V. K. (2006) Vertebrates: Comparative Anatomy, Function, Evolution. 4th edition, McGraw-Hill, New York, NY.
15. Kulshrestha, S. K. (2004) Comparative Anatomy of Vertebrates
16. Milton, H. (1995) Analysis of vertebrate structure. John Niley & Sons Inc, New York

ZCT-1.4: ENVIRONMENTAL BIOLOGY

Teaching Hours per Week: 4
No. of Credits: 4

Unit I: Introduction to Environmental Biology (8)

History, definition, importance, scope, divisions and awareness of environmental biology
Ecosystem: Structure, functions and types- terrestrial, freshwater, marine, estuarine. Biotic and abiotic components, basic loss of energy flow, food chain, food web, ecological pyramids, biogeochemical cycles and ecological succession.

Unit II: Population Growth and Regulation (5)

Types of population growth, physical and biological factors regulating population, population characteristics, mortality, natality, density, age distribution. Population pyramids, population explosion.

Unit III: Natural Resources (6)

Concept and classification of natural resources; Non-renewable resources- land, soil and mineral resources; Renewable resources- water, forest, wildlife, range lands, agriculture, livestock, aquaculture; Energy resources (renewable and non-renewable); Resource management and conservation.

Unit IV: Animal biodiversity (12)

Global and Indian biodiversity; Levels of biodiversity- genetic, species, ecosystem diversity; Endangered species; Values of biodiversity- consumptive, productive, social, ethical, aesthetic (ecotourism) and health values; Conservation of biodiversity- ex-situ and in-situ; Mega-biodiversity centers- National parks, sanctuaries and biosphere reserves, biodiversity hotspots; Threats to biodiversity; Human-wildlife conflicts; Organizations associated with biodiversity management and its conservation.

Unit V: Climate change and environmental pollution (8)

Environmental pollution: air, water, soil, noise, radioactive pollution and their effect on living organisms.

Composition and structure of atmosphere; Climate- catastrophes and driving forces; Human caused climate change- ozone layer depletion, greenhouse gases and global warming, acid rain; Strategies for dealing with global warming

Unit VI: Environment and human health (11)

Types of environmental health hazards- infectious organisms, Toxicants- chemicals, natural and synthetic toxins, heavy metals; Bioaccumulation and bio-magnification; Toxicity measurement- animal testing; environmental legislation and protection.

ZCP 1.8 - ENVIRONMENTAL BIOLOGY PRACTICALS

1. Estimation of pH of different water and soil samples using digital pH meter
2. Estimation of dissolved oxygen (DO) in different water samples
3. Estimation of free carbon dioxide in different water samples
4. Estimation of chlorides in different water samples
5. Estimation of total hardness of different water samples
6. Determination of Biological Oxygen Demand (BOD) in different water samples
7. Estimation of total alkalinity of different water samples
8. Estimation of total dissolved solids in different water samples
9. Estimation of dissolved sulphates in water by turbidometric method
10. Estimation of dissolved phosphates in different water samples by colorimetric method
11. Estimation of organic carbon content of different soil samples
12. Estimation of Chemical Oxygen Demand (COD) in water
13. Any other practical depending on feasibility.

Reference Books:

1. Chapman R. L. & Reiss, M. J. (2000). Ecology – Principles & Application. Cambridge Low Price Edition.
2. Chapman, J.L and Reiss, M.J. (1999): Ecology: Principles and Applications. Cambridge University Press
3. Collin R, Townsend, Harper J L, and Michael Begon (2000): Essentials of ecology. Blackwell Sci. Comp.
4. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
5. Kormondy, E. J. (2007): Concepts of Ecology. 4 th ed. Indian reprint, Pearson Education.
6. Krebs, C J. (1994) Ecology , Harper and Collins
7. Odum E. P. (2008) : Fundamentals of Ecology .Indian Edition. Brooks /Cole.
8. Odum, E. P. and Barret, G. W. (2005). Fundamentals of Ecology. 5 th ed. Thompson Brooks/Cole.
9. Odum, E. P. (1971). Fundamentals of Ecology. W. O. Saunders company, Philadelphia.
10. Odum, E. P. (1983). Basic Ecology. CBS College Publishing.
11. Odum, E.P. (1983) Basic Ecology, Holt Saunders, Japan.
12. Odum. E.P. (1996). Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
13. Paul Colinvaux, (1986): Ecology. John Wiley and Sons, N.Y.
14. Peter Stilling, Ecology: Theory and applications. 2nd ed. Prentice Hall

15. Sharma P.D (2011): Ecology and Environment. Rastogi Publication, Meerut.
16. Environmental Science by WillamP.Cunninsham,Barborawoodworthsaigo
17. The use of Earthworms in waste disposal by Edward, C.A.
18. Introduction to Environmental Engineering & Science Gilbert M. Masters.
19. Essential of Ecology by colin R. Townsend Michael BegonJohn.L.Harper.
20. Environmental Biology -- A.G.Agarwal.
21. Environmental Science by G.Tyler Miller.
22. Toxicology -- Y.K.Lahir.
23. Boughy A S 1971 Fundamental Ecology (Intext Educational Pub.) Pp 222
24. Chenn P 1999 Ecology (John Murray Pub.) Pp 213
25. Collin R, Townsend, Harper J L, and Michael Begon 2000 Essentials of ecology.
(Blackwell Sci. Comp.)
26. Dilip R 1998 Environment management with Indian experience (APH Pub. Cor.)
27. Mackenzie A, Ball A S and Virdee S R 2002 Ecology (Viva Books Pvt. Ltd.) P 339
28. Miller Jr and G T 2002 Living in the environment (Wardsworth, Brooks/Cole)
29. Mishra P C 1990 Fundamentals of Air and Water Pollution (Ashish Publishing
House)
30. Paul W P 1948 Limnological Methods (The Blakistan Co.)
31. Raven P H, Berg L R, Johnson G B 1993 Environment (Saunders College Pub.) pp
569
32. Singh M C 2000 Environment Protection and the Law (Ashish Publishing House)

II SEMESTER

PAPER ZCT 2.1: MOLECULAR GENETICS

Teaching Hours per Week: 4

No. of Credits: 4

Unit I: Mendelian and Modern Genetics (10)

Overview of Mendelian principles and Post-Mendelian Genetics. Concept of alleles, complementation test, cistron, muton and recon. Linkage and crossing over. Non-Mendelian inheritance

DNA structure and functions: DNA as hereditary material – experiments; Watson and Crick model and alternate models of DNA, semi-conservative replication of DNA; DNA repair mechanisms; organization of prokaryotic and eukaryotic genomes. Replication: Enzymology of replication, initiation, elongation and termination; models of replication. Protein synthesis: Genetic code, colinearity hypothesis. Transcription, post-transcriptional modifications; Translation: post-translational modification.

Unit II: Bacterial Genetics (5)

Genetics of bacterium and bacteriophage: Transformation, transduction and conjugation in bacteria; F- mediated sexduction, mechanism of recombination in bacteria, Life cycles of bacteriophage, plasmids and episomes.

Unit III: Gene Regulation in prokaryotes and Eukaryotes (6)

Gene regulation: Prokaryotes- operon model- positive and negative regulation; Eukaryotes - model of gene regulation, transcription factors, Cis and trans acting elements in eukaryotes. Dosage compensation in human, *Drosophila* and *Caenorhabditiselegans*. Genome imprinting

Unit IV. Chromosomal and Gene mutations: (14)

Chromosomal mutations: Deletion, Duplication, Inversion, Translocation and their genetic implications.

Genes mutations: Types and Molecular mechanisms of mutations, transposable elements.

Structural mutations: Point mutations – Silent, missense, and nonsense mutations. Functional mutations: Loss-of-function and

Gain-of-function mutations. Causes of mutations. Mutational analysis in vitro and in vivo.

Unit V: Genetic Diseases (10)

Genetic diseases: Single gene inheritance; cystic fibrosis, sickle cell anemia, Marfan syndrome, Huntington's disease, and, hemochromatosis. Multifactorial inheritance: heart disease, high blood pressure, Alzheimer disease, arthritis, diabetes, cancer, and obesity.

Chromosome abnormalities: Turner syndrome, Klinefelter syndrome, Down syndrome and Cri-du-chat syndrome. Mitochondrial inheritance: Leber's hereditary optic atrophy, epilepsy, myoclonic epilepsy and dementia.

Unit VI: Genomics and Proteomics (3)

Salient features of yeast, *Drosophila* and Human genomes; Evolutionary genomics; Proteomics

ZCP 2.5 - MOLECULAR GENETICS PRACTICALS

- 1-2. Study of polytene chromosomes in: a. Chironomous larva and b. *Drosophila* larva
3. Study of genetics of blood group in Man
4. Study of X-chromatin or Barr body in buccal cell of Human
5. Human Karyotype analysis: a. Normal male, b. Normal female, c. Down syndrome, d. Cri-du-chat syndrome, e. Klinefelter syndrome, f. Turner syndrome, g. Translocation
7. Study of *Drosophila* mutants: Normal male, Normal female, Yellow body, Bar eye, White eye, Vestigial wing, Ebony body, Sepia eye
8. Study of sex comb and genital plate of different *Drosophila* species
9. Study of karyotype of different *Drosophila* species
10. Study of Sternopleural and Acrostical bristles and statistical analysis of *Drosophila*
11. Study of eye pigments of *Drosophila* by paper chromatography.
12. Study of inversions in *Drosophila*.
13. Any other practical depending on feasibility

References Books:

1. Anthony JF Griffiths, Jeffrey H Miller, David T Suzuki, Richard C Lewontin, and William M Gelbart. 2004. Introduction to Genetic Analysis, 7th Edition. W. H. Freeman and Company. New York.
2. Griffiths, Anthony J.F.; Gelbart, William M.; Miller, Jeffrey H.; Lewontin, Richard C. 1999. Modern Genetic Analysis.. W. H. Freeman and Company. New York.
3. Atherley A.G, Girton J.R and J.F.McDonald (1999). The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, N.Y.
4. Brooker RJ (1999) Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.

5. Gardner EJ, Simmons M.J and D.P.Snustad (1991) Principles of Genetics. John Wiley and Sons. Inc. N.Y.
6. Goodenough U (1985) Genetics. W.H. Feeman and Co.N.Y.
7. Hartle D.L and E.W.Jones (1998) Genetics: Principles and analysis. Jones and Bartlett Publishers.
8. Jinks J.A. (1972) Extrachromosomal inheritance, Prentice Hall Inc. N.J
9. Brown T A (1989) Genetics. A molecular approach. Van Nostrand Co. N.Y
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28. The Arabidopsis Genome, 2000 Nature vol. 408.

ZCT 2.2: MOLECULAR CELL BIOLOGY

Teaching Hours per Week: 4
No. of Credits: 4

Unit I: Introduction (4)

Scope of modern cell biology, historical highlights, Introduction to molecular cell biology: Levels of organization. Cell as a morphologic and functional unit within organisms. The central dogma of molecular biology. The scope of modern cell biology. Synthetic biology

Unit II: Molecular organization of biomembranes (8)

Organization and composition of plasma membrane, Fluid mosaic model. Membrane fluidity- role of cholesterol. Membrane asymmetry. Transport across membranes (solutes, gases, ions and water); Passive and active transport, Cell junctions: types, structure and functions .

Unit III: Molecular organization and functions of cell organelles (8)

Endoplasmic reticulum; Ribosomes – Structure, translation and translocation, nascent polypeptide chain, protein folding and processing. Golgi apparatus- signal hypothesis, protein glycosylation, protein sorting and transport, endocytosis and lysosome formation. Mitochondria – bioenergetics, oxidative phosphorylation, protein import and transport metabolites; Peroxisomes.

Cytoskeleton- Molecular organization of microfilaments, Intermediate filaments and microtubules and their role in cell architecture and functioning

Unit IV: Biomolecules (8)

Amino acids- structure and classification, Peptide bond formation. Proteins - primary, secondary and tertiary structures. Polypeptide folding: Random coiling, Alpha helix and Beta sheet. Protein modifications - Glycoproteins, Proteoglycans and Lipoproteins. Carbohydrates - Complex polysaccharides. Lipids – Triglycerides and compound lipids

Unit V: Nucleus and Chromatin Biology (7)

Ultra structure of nucleus and functions. Molecular structure of chromosomes: Euchromatin and Heterochromatin; Role of histones in Packaging DNA; Nonhistone proteins; C- Value Paradox. Nucleolus – organization and functions.

Unit VI: Cell Cycle, Apoptosis, Cancer biology and Immunology (13)

Cell Cycle- Molecular events; Role of Cyclins and Cyclin Dependent Kinases (CDK) in cell cycle. Apoptosis - Mechanism and significance

Cancer Biology - Benign and Malignant tumors; Characteristics and properties of cancer; Development and causes of cancer; Carcinogens; Oncogenes; Oncoviruses; Tumor suppressor genes; Diagnosis and treatment of cancer.

Immunology: Cells and tissues of immune system, types of immunity, T and B lymphocytes; Cytokines, MHC molecules. Immunoglobulins: types, structure and functions of immunoglobulins.

ZCP 2.6 - MOLECULAR CELL BIOLOGY PRACTICALS

- 1) Study of epithelial tissues: ciliated, columnar and squamous, etc.
- 2) Study of nervous tissue: Myelinated and unmyelinated nerve cells
- 3) Study of Muscular tissue : Smooth muscles, striated muscles and cardiac muscle
- 4) Study of connective tissues ; Bone and cartilage; Blood cells – Neutrophils, Basophils, Eosinophils, Lymphocytes and Monocytes
- 5) Estimation of DNA by Diphenylamine (DPA) method
- 6) Estimation of RNA by Orcinol method
- 7) Study of mitosis - observation of permanent slides
- 8) Study of stages of Mitosis in onion root tips
- 9) Study of meiosis – observation of permanent slides
- 10) Study of stages of meiosis in grasshopper testis
- 11) Histopathological examination (HPE) of normal and malignant cells.
- 12) Preparation of stains and fixatives
- 13) Observation of Lactobacillus from the curd sample
- 14) Study of eukaryotes from rectal parasite of frog.
- 15) Any other practical depending on feasibility.

Reference Books:

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2. 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
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20. Karp, G (1996) Cell and Molecular Biology: Concepts and experiments, John Wiley, New York.
21. Lewin, B (Ed) 1996) Genes, VII edition, John Wiley and Sons, New York
22. Kleinsmith, L. J. and Kish V. M (1995) Principles of Cell and Molecular Biology, II edition, Harper Collins College publishers.
23. Sadava, D. E (1993) Cell Biology – Organelles, Structure and function, Jones and Bartlett publication.
24. Schlieff, R. (1986) Genetics and Molecular Biology, Addison Wasley Publishing
25. Sheeler, P. and Bianchi D.E. (1987) Cell and Molecular Biology, III edition, John Wiley New York.
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27. Watson, J. D, Hopkins N. H, Roberts J. W, Steitz J. A and Weiner A. M (1987) Molecular Biology of the Gene, Vol.I& II general principles, IV edition, The Benjamin Cummings Publishing Co., Inc.,
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PAPER ZCT 2.3: ANIMAL PHYSIOLOGY

Teaching Hours per Week: 4

No. of Credits: 4

Unit I: Introduction to Physiology and Physiology of Respiration and Blood (12)

History and central themes of Animal Physiology and its sub-disciplines

Respiration: The atmosphere, solubility of gases, respiratory organs in the vertebrates; Respiratory mechanisms in aquatic and air breathing fishes, birds and mammals; respiration in eggs; Exchange of O₂ and CO₂ and transport. Oxygen dissociation curve

Blood - components and functions; acid-base balance regulation

Circulation: General principle, vertebrate circulation, the physics of flow in tubes, Hemostasis.

Unit II: Water and Osmoregulation (6)

Properties of water molecules; Osmoregulation, osmoregulators and conformers; Obligatory exchanges of ion and water; Osmoregulatory organs; Osmoregulation in aqueous and terrestrial animals

Unit III: Temperature (6)

Classification of animals based on thermal biology.

Temperature effects: effects of temperature change, extreme temperatures-limits to life, tolerance to high temperature, tolerance to cold and freezing temperatures.

Temperature regulation: Body temperature of birds and mammals, heat transfer, heat balance, torpor and hibernation, aestivation.

Unit IV: Feeding and Digestion (12)

Feeding methods and mobility of the alimentary canal; Physiology of digestion and absorption, gastrointestinal secretions; nutritional requirements (micro and macro)

Enzyme catalysis: Enzymes as catalysts, enzyme kinetics, regulation of enzyme activity, active sites, coenzymes, activators, inhibitors, isoenzymes, allosteric enzymes, ribozymes.

Unit V: Muscle physiology (6)

Types of muscles: striated, nonstriated and cardiac muscles. Ultra structure of striated muscle. Muscle contraction – Muscle proteins, sliding filament theory, Energetics of muscle contraction.

Defects in muscle function, muscle coordination diseases, muscular dystrophy

Aging physiology concepts related to muscle function.

Unit VI: Nervous system

(6)

Structural organization and functions of nervous system; Electrochemical, resting and action potential; Transmission of information within neuron, synaptic transmission (electrical and chemical); Neurotransmitters

ZCP 2.6 - ANIMAL PHYSIOLOGY PRACTICALS

- 1) Qualitative analysis of carbohydrates
- 2) Qualitative analysis of polysaccharides
- 3) Qualitative analysis of proteins
- 4) Qualitative analysis of lipids
- 5) Total count of blood corpuscles
- 6) Differential count of WBCs
- 7) Estimation of blood clotting time
- 8) Estimation of protein and hemoglobin
- 9) Estimation of cholesterol and triglycerides
- 10) Analysis of pathological contents of urine
- 11) Estimation of glucose
- 12) Identification of adulterants
- 13) Any other practical depending on feasibility.

References Books:

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3. Pestonjee, D.M. Stress and Copping. Sage Publications, London, 1999.
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7. Randall David., Burggren. W and French, K. Animal Physiology. W.H. Freeman and Co. New York, 1997.

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OPEN ELECTIVE PAPER (FOR OTHER DEPARTMENT STUDENTS)

ZET- 2.4: ECONOMIC ZOOLOGY

Teaching Hours per Week: 4

No. of Credits: 4

Unit I Introduction (8)

Importance of Economic Zoology.

Vermiculture

Establishment of vermiculture unit; Earthworm as a tool for the conversion of biodegradable waste into vermicompost; Earthworms as poultry and fish feed; Vermiwash

Unit II: Apiculture (9)

Beekeeping practices in India; Foraging and colony organization in honeybees; Composition and uses of honey and bee products.

Unit III: Sericulture (9)

Importance of sericulture as a rural industry; Life cycle of Bombyxmori; Modern rearing methods, reeling, grading and marketing. Types of silk. Lac culture: Cultivation and uses of lac.

Unit IV: Fisheries (10)

Introduction: definition, scope and status of aquaculture in India.

Culture techniques of fin fish and shell fish; Composite fish culture; Ornamental fishes; Pearl oyster culture; Fish by-products

Unit V: Poultry keeping (5)

Introduction to poultry and their economic value

Breeding techniques of poultry breeds viz. white leghorn, jungle fowl, giriraj, turkey bird and duck

Housing techniques: diseases of poultry

Marketing of poultry products e.g. Eggs, meat and poultry waste

Unit VI: Dairy management (9)

Introduction: definition, types of indigenous cattle, breeds of cow, breeds of buffalo, high-yielding exotic breeds. Nutritive value of milk and milk products. Cattle by-products

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2. Jhingran, V.G. 1977. Fish and Fisheries of India. Hindustan Publ., New Delhi.
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4. T.V.R. Pillay 'Principles and practice of Aququculture.2nd edition, Fishing News books.
5. R.K.Rath. 'Fresh water aquaculture'.2nd Edition.Scientfic Publishers.Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, ICAR, (2006), DIPA, New Delhi, INDIA.
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