

P.G. 1st Semester

Paper: ZOO701C (Core) Biosystematics of Non Chordates

Credits: 4 = 4+0+0 (64 Lectures)

Unit 1: Biosystematics and Taxonomy:

16L

1. Basic concept of Biosystematics, taxonomy and classification; classical and recent taxonomic parameters 2. Newer trends in biosystematics- chemo, cyto and molecular taxonomy (DNA barcoding in explaining 3. Taxonomic key, its types and their role in classification 4. Taxonomic characters and significance, ICZN, 5. Introduction of Species concept, biological and evolutionary species concept, difficulties in application of biological species concept, Supra and infra-specific and sibling species categories.

Unit 2: Biological classification:

18L

1. Theories of biological classification, 2. Phylogenetic types of classification, systematic of animals and hierarchic classification, Zoological nomenclature-basic knowledge of naming on genus and species; Modern scheme of classification into sub-kingdom, division, section, phyla and minor-phyla. 3. Phenetic method of classification, numerical phonetics and numerical taxonomy, preparation of data matrix and similarity matrix using distance method (Manhattan distance and Euclidian distance), 4. Cladistic method of classification, difference in application of phonetic and cladistic classification, Cladogram, Eludistic methods.

Unit-3: Functional biology of non-chordates:

18L

1. Osmoregulation in protozoa; 2. Colonial protozoans and theories of origin of metazoans; 3. Feeding pattern and digestion in lower metazoans, 4. Life history pathogenecity and control of *Fasciola hepatica*, 5. Exocrine gland (Lac, Wax, Silk and Labial gland), 6. Larval forms of echinoderms, metamorphosis and phylogenetic significance, 7. Structure and function of digestive organs in insect-pleotropic membrane and filterchamber 8. Hydrostatic movement in Echinodermata and Annelids 9. Mechanism of respiration by gills, book lung and trachea 10. Respiratory pigments in non-chordates 11. Mechanism of Excretion and excretory organs in Annelids and Arthropods.

Unit-4: Minor phyla

12L

Salient features and affinities of- 1. Placozoa, 2. Mesozoa, 3.Ctenophora, 4. Rotifera, 5. Phoronida, 6. Sipuncula, and 7. Bryozoa (Ectoporecta).

Books recommended:

1. Barnes: Invertebrate Zoology (Holt-Saunders International, 4th edition, 1980)
2. Barnes: The Invertebrates – A synthesis, 3rd edition, Blackwell, 2001
3. Hunter: Life of Invertebrates, Collier Macmillan Pub. 1979
4. Marshall: Parker & Haswell Text Book of Zoology, Vol. I, 7th edition, Macmillan, 1972
5. Moore: An Introduction to the Invertebrates, Cambridge University Press, 2001
6. Jordan & Verma: Chordate Zoology (1998, S. Chand)
7. Sinha, Adhikari & Ganguly: Biology of Animals (Vol. II, 1998, New Central Book Agency)
8. Chapman: The Insects: structure and function, 1998

9. Srivastava: A text book of applied entomology Vol I & II Kalyani Publishers, New Delhi, 1988, 1993
10. Kapoor V. C.: Principles of Taxonomy
11. Parker and Haswell: A Textbook of Zoology Vol. I (Revised)
12. E. Mayr and P.D. Ashlock : Principles of systematic Zoology (2 nd Edition)

Paper: ZOO702C (Core)
Biochemical and Biophysical Science
Credits: 4 = 4+0+0 (64 Lectures)

A. Biochemical science:

Unit-1: General biochemistry

- 4.1 Water and biomolecules: **14L**
 1. Biological importance of water, PH, PK and acid-base balance, Henderson-Hasselbach equation 2. Types of Buffers and Biological importance 3. Electrolyte and water balance, Acidosis, Alkalosis 4. Concept of chemical bonding, its types and biological application 5. Role of Carbon in life and its variety of functional group/ variety of functional groups of carbon and its biological role 6. Natural products, their physiological & pharmacological importance
- 4.2 Protein chemistry and function: **14L**
 1. Protein structure and significance- Primary structure: peptide bond. Secondary structure (α helix, β pleated sheet and bends) 2. Ramachandran plot. 3. Tertiary structure: forces stabilizing tertiary structure, domain and motifs. Quaternary structure 4. Protein-protein interaction 5. Ligand and types of biological ligands. Ligand formation between protein and nucleic acid 6. Lipid and its role in biomembrane.

Unit-2: Functional biology of nucleic acid **8L**

1. Structure, folding motifs, conformational flexibility and supercoiling of DNA 2. Mechanism of DNA replication 3. RNA-Transcription and post-translational modification

B. Biophysical science:

Unit-3: Bioenergetics **16L**

1. Forces between molecules (electrostatic, van der Waals forces - hydrophobic and hydrophilic) and their biological importance, 2. Laws of thermodynamics (zeroth, first, second laws) 3. Concept of free energy (Gibbs), entropy and calculation based on free energy change, Endothermic and exothermic reactions. 4. Biological applications of thermodynamics (open and closed systems). 5. Third law of thermodynamics - significance of hydrophobicity and entropy in biological reaction system. Free energy and equilibrium constant of reactions, coupled reaction. 6. Bioenergetics of muscle contraction.

Unit-4: Enzyme kinetics and metabolism **12L**

- 4.1 **Enzyme action** **4L**
 1. Mechanism of enzyme action (active site, substrate binding site, transition state analogue). 2. Concept of regulation of enzyme activity. 3. Ribozyme, abzyme and isoenzyme and their biological and medico-significance.

4.2 Metabolism **4L**

1. Concept of metabolic pathway and their regulation. 2. Energy transduction - glucose and fatty acid as energy sources/ metabolic fuel 3. Respiratory chain and oxidative phosphorylation, 4. Metabolic disorder.

4.3 Enzyme Kinetics **4L**

1. Kinetic analysis of enzyme catalyzed reaction, Derivation Michaelis–Menten equation and related calculations (Lineweaver–Burk plot). 2. Lowering of activation energy.

Books recommended:

1. Albert et al.: Molecular Biology of the Cell (4th Ed.), Garland Publishing Inc., 2002
2. Lodish et al.: Molecular Cell Biology (5th Ed.), Freeman and Company, 2004
3. Berg et al.: Biochemistry (5th Ed.), Freeman and Company, 2002
4. Murray et al.: Harper's Biochemistry (26th Ed.), Appleton & Lange, 2003.
5. Bose, S. Elementary Biophysics. Jyoth Books, 1982.
6. Bums, D.M. and MacDonald, S.G.G.. Physics for Biology and Premedical students. ELBS and Addison - Wesley Publishers Ltd., London, 1979.
7. Casey, E.J. Biophysics concepts and Mechanism. Affiliated East-West Press Pvt. Ltd., New Delhi, 1962.
8. Das, D. Biophysics and Biophysical Chemistry. Academic Publishers. New Delhi, 1982.
9. Epstein, H.T.. Elementary Biophysics, selected topics. Addison - Wesley Publishing Company Inc. London, 1963
10. Das, D. Biophysics and Biophysical Chemistry. Academic Publishers. New Delhi, 1982.

Paper: ZOO703C (Core)
Computational and Quantitative Biology
Credits: 4 = 4+0+0 (64 Lectures)

A. Computational Biology

Unit 1: Computational biology & bioinformatics

1.1: Computational biology 10L

1. Computational biology-definition & different branches and application 2. Biometrics-identification system, accuracy and technologies, finger scan & facial scan and application 3. Bioinformatics-brain of biotechnology.

1.2: biological data bases 18L

1. Introduction to Genomic Data and Data Organization. 2. Sequence Data Banks –Introduction to sequence data banks: protein sequence data bank, NBRF-PIR, SWISSPORT, UNIPROT 3. Nucleic Acid sequence data bank – GenBank, EMBL. 4. Structural data bank – protein data bank, PDB and SCOP, The Cambridge Structural database (CSD), 5. Sequence Analysis – Analysis tools for sequence data banks, 6. Pair – wise alignment – NEEDLEMAN AND WUNSCH ALGORITHM, 7. SMITH WATERMAN 8. Multiple alignments – CLUSTAL, BLAST, FASTA algorithm to analyze sequence pattern, motifs and profiles Sequence retrieval system (SRS), Protein identification resource (PIR); 9. File formatting-FASTA, GCG and ClustalW.

Unit 3: Quantitative biology -1 **18L**

1. Variance, standard deviation, standard error, 2. measure of skewness and Kurtosis, 3. coefficient of variance & calculation. 4. Basics of Probability – Concept of probability, addition and multiplication laws of probability and application to the problems of biology; 5. Probability distribution – Definition, Types (bernoulli, binomial, poisson and normal distributions), properties and applications.

Unit4: Quantitative biology-2**18L**

1. Sampling- a) Concept of sampling and sampling methods, b) Test of significance for large sample (Z-test) and for small sample (t-test). c) Hypothesis formulation and testing of Hypothesis
2. Chi-square analysis (goodness of fit, f-test). 3. Correlation: a) Definition types of correlation, b) Methods of studying correlation, Karl Pearson coefficient of correlation, Rank correlation method. 4. Regression analysis. 5. Analysis of variance.

Books recommended:

1. Barnes & Gray (ed): Bioinformatics for geneticists, Wiley (2003)
2. Lesk: Bioinformatics, Oxford (2003, Indian ed)
3. Westhead et al: Bioinformatics Instant Notes, Viva Books (2003, Indian ed)
4. Bruning J.L. and B. L. Kintz Computational Handbook of Statistics, Scott, Foresman and Company (1977).
5. Daniel W.W. Biostatistics: A Foundation for Analysis in Health Sciences, John Wiley (2000).
6. Milton J.S. and J.O. Tsokos Statistical Methods in the Biological and Health Sciences, McGraw Hill Book Co. (1983)
7. Quinn G.P. and Keough M.J. (2002) Experimental Design and Data Analysis for Biologists, Cambridge Univ. Press.
8. Techniques in life sciences – by Tembhare
9. Practical Biochemistry By Plummer
10. Principles and techniques of Practical Biochemistry Ed. B.L. Williams & K. Wilson, Arnold Publishers

Paper: ZOO704C (Core)**Parasitology and Vector Biology, Immunological Sciences & Microbiology****Credits: 4 = 4+0+0 (64 Lectures)****Advanced Parasitology and Vector Biology****25L****Unit 1: Parasitology****17L****1.1: General consideration of parasites:**

1. Types of parasites, Type of hosts, parasite relationship-Symbiosis and commensalism
2. Distribution of diseases and Zoonosis caused by animal parasites
3. Molecular interaction between host & parasites and evasion of immunity
4. Biochemical adaptations of parasites & parasites of veterinary importance.

1.2: Protozoan parasite

1. Distribution, habit and habitat, structure life cycle and diseases caused by selected pathogenic protozoan parasites of man: a) Entamoeba histolytica, b) Trypanosoma gambiense, c) Leishmania donovani, 2. Physiology of parasitic amoebae of man.

1.3: Helminth parasites

1. General characters, organization and larval forms of Platyhelminthes and Nematelminthes
2. Distribution, habit and habitat, structure and life cycle of economically

important helminth parasites of man and domesticated animals: a) Echinococcus granulosus, b) Schistosoma haematobium, c) Trichinella spiralis, d) Wuchereria bancrofti

Unit 2: Vector biology

8L

1. Vectors – insect vectors, mosquito, housefly, bedbug, head louse; 2. Biology of different mosquito; 3. Vector born diseases – human diseases and their control measures 4. Vectorborne viral disease – Dengue and Japanese encephalitis 5. Vector control – Biological, chemical and physical methods

B. Immunological sciences and microbiology (39L)

Unit 3: Immunology

24L

1. Cells of the immune system: T- cell generation activation and differentiation, B-cell - generation activation and differentiation; 2. Antibody: types, structure, function, production and diversity; 3. Epitopes and haptens; 4. Major Histocompatibility Complex (MHC)- general organization and inheritance of the MHC, MHC molecules and genes; 4. Complement system- classical, alternative and lectin pathways, regulation of complement system, biological consequences of complement activation; 5. Cytokine receptors- properties of cytokines, cytokine receptors, cytokines 6. Hypersensitivity reactions- types, mechanisms of type I to IV hypersensitivity reactions; 7. Autoimmunity and Organ specific autoimmune diseases (Rheumatoid arthritis, Grave's disease and treatment); 8. Transplantation immunology- blood antigens, transplantation rejection, graft rejection, immune suppression.

Unit 4: Microbiology

15L

1. Structure and growth of bacteria; 2. Structure of virus & reproduction (Lytic cycle, Lysogenic cycle & Role of lambda repressor); 2. Pathogenic microbes - Rabies, 3. Viral disease-, Zika, Nipah, HIV, H1N1.; 4. Antibiotics: Chemistry their mode of action 5. Vaccine: Types, Vaccine preparation.

Books recommended:

1. Animal parasitology – J. D. Smyth (Cambridge Univ. Press., 1976).
2. Foundations of parasitology 6 ed. – L. S. Roberts & J. Janovy Jr (McGraw Hill Publ., 2000).
3. Parasitism – A. O. Bush, J.C. Fernandez & J. R. Seed (Cambridge Univ. Press, 2000).
4. Helminthology – Eds. N. Chaudhury & I. Tada (Narosa Publ. House, 1994).
5. Helminthes, Arthropods, & Protozoa of domesticated animals 6 ed. – E.J.L. Soulsby (ELBS, 1976).
6. Introduction to parasitology – B.E. Matthews (Cambridge Univ. Press. 1998).
7. Ecological Animal Parasitology – C. R. Kennedy (Blackwell Scientific Publ., 1975).
8. Immunology, Kuby, W.F. Freeman, U.S.A
9. Fundamentals of Immunology, W. Paul

Paper: ZOO705L (Lab)
Lab1: Zoology Core Course Laboratory

Credits: 4 = 0+0+4

(i): Practical on Biosystematics of non-chordates

1. Taxonomic hierarchical classification invertebrate specimens of non-chordates by local, binomial nomenclature(at least 3 representatives of museum specimen from each phyla) & 2 minor phyla
2. Identification of at least one specimen from each typological species(supra, infra & sub species categories)
3. Permanent mounting(any three)
 - a) Protozoa (cilia-*Paramoecium*, flagella- *Euglena*)
 - b) Porifera- fresh water sponges spicules, Coelenterata- *Obelia* colony
 - c) Cockroach – salivary gland and trachea, Daphnia, Cyclops
4. Study of permanent slides: Zoea, Megalopa(crustacean larvae), Glochidium, Echinoderm larvae
5. Study of Invertebrate fossils
6. Dissection: a) Mouth parts of Cockroach, House fly, Mosquito; b) Reproductive system of cockroach c) Nervous system of cockroach

(ii): Biochemical and biophysical sciences

1. Construction of models of biomolecules by wire and bits.
2. Preparation of different buffers and determination of pH by pH meter.
3. Chromatographic separation of amino acid and protein (in body fluid and tissue)/ phytochemical by TLC.
4. Enzyme kinetics – In vitro detection of salivary amylase activity from cockroach or maltose standard/pepsin or trypsin (from stomach of toad).
5. Quantitative estimation of protein by SDS-PAGE electrophoresis (Demonstration)
6. Quantitative estimation of glucose and protein.
7. Separation of nuclei, cell debris, mitochondria by differential centrifugation.

(iii): Biostatistics, bioinformatics and tool technique

1. Data processing and graphical presentation of data (bar diagram, histogram, pie chart) using excel sheet.
2. Calculation of measure of central tendencies (mean and median), dispersion (standard deviation, coefficient of variance) from the data collected/provided.
3. Computation of test of significance (T-test) from the data collected/ provided.
4. Computation one-way ANOVA in computer by using suitable software/Excel.
5. Download protein and nucleotide sequences through browsing suitable databases and report to be submitted (Protein sequence: Hb, Myoglobin, TATA/box binding protein. Nucleotide sequence: Cry1AC, BCL2/HSP70 gene etc).
6. Design of a primer for gene amplification (offline and online for forward and reverse) and annotation, ORF finder for eukaryotic gene use of ARTEMIS or any other suitable software.
7. Construction of phylogenetic tree (through Clustal W, Megablast 7/PHYLIP) for DNA and protein for any five suitable vertebrate and invertebrate animals and their interpretation.

(iii): Biostatistics, bioinformatics and tool technique

1. Data processing and graphical presentation of data (bar diagram, histogram, pie chart) using excel sheet.
2. Calculation of measure of central tendencies (mean and median), dispersion (standard deviation, coefficient of variance) from the data collected/provided.
3. Computation of test of significance (T-test) from the data collected/ provided.
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6. Design of a primer for gene amplification (offline and online for forward and reverse) and annotation, ORF finder for eukaryotic gene use of ARTEMIS or any other suitable software.
7. Construction of phylogenetic tree (through Clustal W, Megablast 7/PHYLIP) for DNA and protein for any five suitable vertebrate and invertebrate animals and their interpretation.

(iv): Advanced parasitology and vector biology, immunological and microbial science Parasitology:

1. Identification of dipteran vectors and study of different stages of the life history of Anopheles Culex, Aedes, housefly, sandy fly (through slides/chart).
2. Preparation of permanent slide of insect leg, antennae, wings of mosquito/housefly/cockroach.

Vector biology:

1. Surveillance and writing a report on breeding habitat of mosquito/cockroach. Study of mosquito/housefly diversity species. 1. Histological identification: Primary and secondary lymphoid organs through prepared slide.
2. Preparation of single cell suspension from bone marrow and spleen of mice. Cell-viability assay and cell counting from spleen (splenocyte)/thymus.
3. Preparation and study of phagocytosis from splenic/peritoneal macrophages. Performing theagglutination or precipitation test in ABO blood group

Immunology:

1. Histological identification: Primary and secondary lymphoid organs through prepared slide.
2. Preparation of single cell suspension from bone marrow and spleen of mice. Cell-viability assay and cell counting from spleen (splenocyte)/thymus.
3. Preparation and study of phagocytosis from splenic/peritoneal macrophages. Performing theagglutination or precipitation test in ABO blood group

Microbial science:

1. Media preparation for microbial culture. Gram staining of bacteria (*Lactobacillus*).

Viva Voce

Practical Records

Paper: ZOO706S (SEC)
Seribiology & Sericulture Practices
Credits: 2 = 2+0+0 (32 Lectures)

Unit 1: Introduction	6L
1. Sericulture: Definition, history and present status; Silk route 2. Types of silkworms, Distribution and Races 3. Exotic and indigenous races Mulberry and non-mulberry Sericulture	
Unit 2: Biology of Silkworm	6L
1. Life cycle of Bombyx mori 2. Structure of silk gland and secretion of silk	
Unit 3: Rearing of Silkworms	8L
1. Selection of mulberry variety and establishment of mulberry garden 2. Rearing house and rearing appliances 3. Disinfectants: Formalin, bleaching powder, RKO 4. Silkworm rearing technology: Early age and Late age rearing 5. Types of mountages, Spinning, harvesting and storage of cocoons	
Unit 4: Pests and Diseases	6L
1. Pests of silkworm: Uzi fly, dermestid beetles and vertebrates 2. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial 3. Control and prevention of pests and diseases	
Unit 5: Entrepreneurship in Sericulture	6L
1. Prospectus of Sericulture in India: Sericulture industry in different states, 2. Employment, potential in mulberry and non-mulberry sericulture. 3. Visit to various sericulture centers.	

Books recommended:

1. Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
2. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
3. Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
4. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
5. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
6. Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
7. Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
8. A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.