

P.G. 2nd Semester

**Paper: ZOO801C (Core)
Analytical Techniques and Molecular Biology**

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

A. Functional biology of chordate (38L)

Unit1:: Vertebrate body plan 12L

1. Mechanism of body support & movement 2. Ectothermic and exothermic mode of life; 3. Jaw suspension- functional & evolutionary significance, cranial kinetics, intra-cranial feeding mechanism 4. General plan of neurocranium & dermatocranium 5. Temporal regions of reptiles, evolutionary significance; 6. Dentition & dentition formula in mammals; 7. Modification in beak, feet, palates in birds

Unit 2: Functional diversity of chordates 14L

1. Aerial respiration in vertebrates; 2. Evolution of cerebrum, Association of CNS, information process, encephalisation in higher brain; 3. Nitrogen excretion in vertebrates; 4. Communication signals- bioluminescence, pheromones, coloration & mimicry; 5. Accessory respiratory organs in fish & air-sac in birds; 6. Adaptations to Stress- basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones; 7. Body fluids- major types of body fluids & fluid compartments: 8. Bonding biodiversity- molecular diversity & cellular diversity in terms of functional diversity.

Unit 3: Receptors in vertebrates 12L

1. Characteristics of general receptors, receptor potential & sensory coding; 2. Sense organs & simple receptors- organs of olfaction & taste, lateralline system, electro-reception; 3. Adaptation in organ system for reception- chemo- receptors & electrical receptors.

B. Biodiversity and conservation

Unit4: Biodiversity and conservation (26L)

4.1: Introduction to biodiversity 8L

1. Definition & indices of biodiversity 2. Biodiversity hotspot with reference to NE region 3. Types of biodiversity 4. Levels of biodiversity- genetic, species & ecological diversity 5. measuring biodiversity; interrelationship between diversity measures; pattern of local and regional biodiversity. 6. Species interaction

4.2: Biodiversity conservation 10L

1. Biodiversity conservation- methods & strategy formation 2. Threats to biodiversity- vulnerability of species extinction; 3. Red data book; rarity, endemism, effective and minimum viable population, 4. Fragmentation of population and metapopulation

4.3: Economic importance of biodiversity 8L

1. Forest Biodiversity for medical use
2. Values and uses of biological diversity
3. Invertebrate diversity as bioindicator; putting a price on biological diversity; pollinating insect diversity and their management and utilization in sustainable agriculture.

Books recommended:

1. Boolootian, R. A. and Stiles, K. A., College Zoology, 10th edition, Macmillan Publishing Co., Inc. New York, 1981.
2. Colbert, E. H., Morales, M. and Minkoff, E. C. Colbert's Evolution of the Vertebrates: A history of the backboned animals through time, 5th edition, John Wiley - Liss, Inc., New York, 2002.
3. Farner, D. S. and King, J. R., Avian Biology (in several volumes), Academic Press, New York, 1971.
4. Goodrich, E. S., Studies on Structure and Development of Vertebrates, Dover Publication, New York, 1958.
5. Hildebrand, M. Analysis of Vertebrate Structure, 4th edition, John Wiley & Sons, Inc., New York, 1995.
6. Jordan, E. L. and Verma, P. S., Chordate Zoology. S. Chand & Company Ltd, 1998.
7. Kotpal, R. L. The Birds, 4th edition, Rastogi Publications, Shivaji Road, Meerut, 1999.
8. Primark : A Primer of Conservation Biology (2nd ed. Sinauer Associates)
9. Odum. E.P. Fundamentals of Ecology. Nataraj Publishers, Dehra Dun, 1996.
10. Berwer. A. The Science of ecology. Saunder's college publishing, 1988.

Paper: ZOO802C (Core) Cell Biology and Genetics

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

A. Cell biology & Cellular dynamics (30L)

Unit1: Cell biology (20L)

1.1. Membrane transport: 10L

1. Structural organization of cell membrane; 2. Transmembrane transport of ions and small molecules (active, passive & bulk transport), Donnan equilibrium; 3. Membrane targeting of proteins; vesicular trafficking between membranes, Post-translational modifications, protein sorting; 4. Nuclear Transport – Import and Export of protein; Export of different RNAs; 5. Nucleo-cytoplasmic interactions & their role.

1.2: Cell cycle and cell death 10L

1. Eukaryotic Cell cycle- phases & cell cycle control, cyclin & cyclin dependent kinase; 2. Check point & regulation; 3. Apoptosis- cellular & molecular events; 4. Cancer – Phenotypic characters of cancer cells; Genetic basis of cancers: Protooncogene, Oncogene, Tumor suppressor genes, Oncogenesis, Stem cells and differentiation.

Unit2: Cellular dynamics 10L

1. Cytoskeleton-Structure of a) microfilaments; b) microtubules; c) intermediate filaments; d) molecular motors; 2. Their role in cell shape and motility, cell structure and dynamics; 3. Cell Signaling- their role in Cell-cell interaction.

B. Cytogenetics & population genetics

Unit 3: Cytogenetics (23L)

3.1: Chromatin structure: 11L

1. Eukaryotic chromatin structure and chromosome organization; 2. Chromosomal proteins: histones and their modifications, non-histone proteins, scaffold/matrix Proteins; 3. Levels of chromatin condensation at interphase and metaphase stages; 4. Centromere, kinetochore and telomere;

3.2: Human cytogenetics & genetic diseases 12L

1. Karyotype and nomenclature of metaphase chromosome bands, 2. Genetic counseling, 3. Common syndromes caused by aneuploidy, mosaicism, deletion and duplication 4. molecular basis for a) Hemophilia, b) Sickle cell anemia, d) Thalassemia, e) Xerodermapigmentosum, f) Cystic fibrosis, g) Duchenne muscular dystrophy 11L

Unit 4: Population genetics 11L

1. Hardy-Weinberg's law of equilibrium. 2. Forces of destabilization-mutation & mutation rates, natural selection- gamete, recessive & lethal selection, heterozygote advantages. 3. Factors changing allelic frequencies-mutation, selection, genetic drift, migration, meiotic drive 4. Variation- genetic polymorphism, causes of genetic variation, population variation. 5. Measure of genetic variation 6. Optimum phenotype selection, Fisher's pressure, genetic homeostasis, genetic load & death, mutation load 7. Inbreeding : Measure of inbreeding. Inbreeding depression, heterosis; Gene & environment interaction

Books recommended:

1. Alberts et al, Molecular Biology of the Cell, Garland, 2002
2. Lodish et al, Molecular Cell Biology, Freeman, 2004
3. Rooney & Czepulkowski, Human Cytogenetics-A Practical Approach, IRL, 1987
4. Strachan & Read, Human Molecular Genetics, Wiley, 1999
5. Watson et al, Molecular Biology of the Gene, Pearson, 2004
6. General genetics by Winchester
7. Molecular Biology of gene by Watson et al. Vol I & II
8. Genetics by Strickberger
9. Molecular Biology by Friefelder
10. Genetics by P.K. Gupta

**Paper: ZOO803C
Developmental Biology
Credits: 4 = 4+0+0 (64 Lectures)**

A. Developmental biology

Unit 1: Gamete biology & early development (18L)

1. Gametogenesis, 2. Fertilization in mammals: Isogamy & heterogamy, Recognition of gametes and acrosomal reaction, Prevention of polyspermy and gamete fusion, Activation of egg metabolism 3. Cryopreservation of gametes & embryo; 3. Cleavage pattern & chemical changes during cleavage, 4. Role of nucleus & cytoplasm during early development, 5. Morphogenesis- morphogenetic movement during development, 6. Gastrulation: Presumptive areas & Fate maps, cell movement and formation of germ layers in mammal, 7. General concept of potency, commitment, specification,

induction (mesoderm development), competence & determination (imaginal discs of insects) 7. Axis & invertebrate.

Unit2: Organogenesis

20L

1. Cell-cell interaction, 2. Neurulation (neural tube formation) & primordial organ rudiments formation, 3. Origin & fate of neural crest cells, 4. Trans-differentiation & its medical implication- Metaplasia & regeneration; 5. Homeobox genes in patterning; 6. insect imaginal disc; 8. Late embryonic development- Vulva formation in *Caenorhabditis*; 9. Regeneration of Salamander limbs: Polar Coordinate model, 10. Teratogenesis

B. Reproductive physiology

Unit 3: Reproductive physiology

17L

1. Implantation & pregnancy, placental structure & hormones, 2. Endocrine, genetic & immunological factors influencing pregnancy; 3. Parturition & lactation- recent concept of physiological mechanism of parturition, hormonal control of lactation & physiological importance.

Unit 4: Medical embryology

9L

1. Infertility; 2. Gamete manipulation –a). Multiple ovulations and In-vitro fertilization (IVF), b).Gamete Intrafallopian transfer (GIFT), c). Intra cytoplasmic sperm injection (ICSI), e). Chimera formation, 3. Multiple ovulation & embryo transfer technology (MOET) 3. Embryonic stem cells- application, economical & clinical significance, Surrogacy, Cryopreservation of gametes.

Books recommended:

1. Adashi and Leung (eds): The Ovary, Raven Press, 1993.
2. Adashi et al: Reproductive endocrinology, Surgery and Technology, Lippincott-Raven publishers, 1996.
3. Findlay, J.K.: Molecular Biology of the Female Reproductive System, Academic Press, San Diego, 1994.
4. Knobil & Neil (eds.): The Physiology of Reproduction, Vol. I & II, Raven Press, 1994.
5. Lamming (eds.): Marshall's Physiology of Reproduction. Longman, Green & Co., 1984.
6. Mann & Lutwak-Mann: The Male Reproductive Function and Semen, Springer-Verlag, 1981.
7. Paulson et al (eds.): Andrology: Male Fertility and Sterility, Academic Press, 1986.
8. Yen et al (eds): Reproductive Endocrinology, W.B. Saunders, 1999.
9. Introduction to embryology by Balinsky
10. Developmental Biology S. Gilbert
11. Developmental Biology by Beryll

Paper: ZOO804C

Ecology and Environmental Science, Wildlife Biology

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

A. Ecology & population ecology

Unit 1: Ecology

(44L)

1.1: Principle of ecology

8L

1. Introduction to ecology, 2. Evolutionary ecology, environmental concepts – laws and limiting factors, ecological models. 3. Biotic potential & environmental resistance. 4. Soil, types & important soil for vegetation.

1.2 Pollution Ecology: 8L

1. Definition, sources, kind of pollutants, primary and secondary pollutants. 2. Definition, source, its effects and control of a) air pollution, b) Water, Pesticide, Soil pollution, c) Sound pollution, d) Radioactive pollution, 6. Bioaccumulation, biomagnification, bio transformation of xenobiotic biomedical and hazardous work.

1.3: Population ecology & species interaction 12L

1. Characteristics of population, population size 2. Population dynamics- a) Intrinsic rate of natural increase; b) Population growth form (sigmoid curve, J curve and hyperbola), logistic equation and concepts relating to growth); c) life history pattern, fertility rate and age structure; d) Population fluctuations and cyclic oscillation; e) Population density and structures; f) r- and k- selections and carrying capacity; 3. Competition and coexistence, intra-specific and inter-specific interactions, 4. Scramble and contest competition model, mutualism and commensalism, prey-predator interactions; 5. Ecological genetics- Importance of genetics to ecological, reproductive system & genetic censures of different reproductive systems

1.4: Nature of ecosystem 8L

1. Nature of ecosystem, 2. Energy flow through ecosystem, 3. Biogeochemical cycles, 4. Resilience of ecosystem, 5. Ecosystem management. 5. The biosphere, biomes and impact of climate on biomes. 6. Types of ecosystem – freshwater, marine and terrestrial 7. Wetland-the kidney of nature.

1.5: Concept of habitat 8L

1. Concept of habitat & niche-Definition & characterization of habitat niche determination, Gaussian principles 2. Species co-existence & community structure 3. Trophic levels & its organization with reference to energy transfer.4. Ecotone concept and edge effect;

B. Environmental biology & Wildlife ecology

Unit 2: Environmental biology 7L

1. Introduction to environmental biology, 2. Concept of environment structure; 3. Environmental Stresses and their management

Unit 3: Wildlife ecology 3L

1. Forest and wild life ecology- 2. Concept of indicator species and their environmental significance. 3. Wildlife biology as resource, food, nutrition, requirements etc.

Unit 4: Conservation biology 10L

1. Wildlife conservation and management; 2. Social forestry & tribal welfare of north. 3. National legislations for protecting biological resources – Biodiversity Act, 2002 and Biodiversity Rules, 2004, 4. Important wildlife sanctuaries & national parks in Assam & India in relation to specific conservation to wildlives. 5. Man-animal conflict in Assam-causes & their solution. 6. International bodies for conservation with reference to red data book.

Books recommended:

1. Harborne : Introduction to Ecological Biochemistry 4th Ed. Academic Press, 1993.
2. Schoonhoven et al.: Insect-Plant Biology, Chapman and Hall 1998.
3. Chapman and Reiss : Ecology - Principles and applications, Cambridge University Press, 1995.
4. Ricklefs and Miller : Ecology 4th ed. Freeman and Co. 2000.
5. Turk and Turk : Environmental Science, 4th ed. Saunders, 1993
6. Primark : A Primer of Conservation Biology, 2nd ed. Sinauer Associates
7. Calabrese : Pollutants and High-Risk Groups, John Wiley, 1978

8. Raven, Berg, Johnson : Environment, Saunders College Publishing, 1993
9. Sharma : Ecology and Environment, Rastogi Publication, 7th ed. 2000
10. Dasmann, R., 1981. Wildlife Biology, 2nd ed. John Wiley and Sons, NY
11. Dobson, A. P. 1996. Conservation and Biodiversity. Scientific American Library, New York, U.S.A.
12. Jeffries, M. J. 1997. Biodiversity and Conservation. Routledge, New York, New York, U.S.A.

Paper: ZOO805L (Lab)
Lab 2: Zoology Core Course Laboratory

Credits: 4 = 0+0+4

(i): Functional biology of chordates and Biodiversity

1. Study of skull types with reference to jaw suspension-fish, frog, calotes, snake, rat/rabbit (guineapig)
2. Dissection of accessory air-breathing organ from any one of marketed specimen (Anabus, Clarius, Heteropneustes/ Channa sp.).
3. Animal population study through quadrat analysis(ants)
4. Enumerate biological diversity(zooplanktons& birds) from large habitat (freshwater lake/ water body) within the vicinity of the city
5. Study of Pung mark of tiger.

(ii): Cell biology and genetics

1. Study of structure of prokaryotic cell by staining preparation of Lactobacillus from curd
2. Study of structure of eukaryotic cell from the permanent preparation
3. Study of eukaryotic cell organelle by making preparation with suitable stain/permanent slides/ photographic model (nucleus, mitochondria, Golgi apparatus, liposome, centrioles, ER).
4. Study of polytene chromosome from Chironomouslarva
5. Study of sex chromatin (Barr body) from buccal epithelia
6. Measurement of cell size by ocular & stage microscope
7. Identification of male & female Drosophila
8. Study of genetic frequency of human ABO blood group to see the validation of Hardy-Weinberg equation & its significance in population genetics

(iii): Developmental biology

1. Estimation of LDH activity
2. Histological slides of reproductive organs
3. Study of different phases of estrous cycle from vaginal smear of rat/ mouse
4. Study of different types of eggs on the basis of yolk content
5. Study of different developmental stages of amphibia& chick embryo(whole mount permanent slides)

6. Study of different types of mammalian embryo(already existing preserved embryo)
7. Study of developmental stages of human embryo(through already existing model)

(iv): Ecology, Environmental Science and wildlife biology

1. Determination of pH, temperature, turbidity from collecting samples.
2. Analysis of types of phyto and zooplankton for the near by sampling of water bodies.
3. Determination of primary productivity by dark and light bottle method.
4. Determination of relative humidity by hygrometer and anerometer.
5. Field visit to and submission of report.