

CORE COURSE: ZOOLOGY  
PAPER XI  
DEVELOPMENTAL BIOLOGY  
(CREDITS: THEORY-4, PRACTICALS-2)  
THEORY

LECTURES 60

Marks 75

Unit 1: Introduction

History and basic concepts: Epigenesis, preformation, Mosaic and regulative development; Discovery of induction; Cell-Cell interaction; Pattern formation; Differentiation and growth; Differential gene expression; Cytoplasmic determinants and asymmetric cell division.

Unit 2: Early Embryonic Development

Gametogenesis (Spermatogenesis, Oogenesis); Types of eggs; Egg membranes; Fertilization: Changes in gametes, monospermy and polyspermy; Planes and patterns of cleavage; Early development of frog and chick up to gastrulation; Fate maps; Embryonic induction and organizers.

Unit 3: Late Embryonic Development

Fate of germ layers; Extra-embryonic membranes in birds; Implantation of embryo in humans and Placenta (Structure, types and functions of placenta).

Unit 4: Post Embryonic Development

Metamorphosis: Changes, hormonal regulations in amphibians; Regeneration: Modes of regeneration (epimorphosis, morphallaxis and compensatory regeneration); Ageing: Concepts and models.

Unit 5: Implications of Developmental Biology

Teratogenesis: Teratogenic agents and their effects on embryonic development; *in vitro* Fertilization; Stem cell culture and Amniocentesis.

PRACTICAL Marks 25

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 developmental stages (above mentioned) by raising chick embryo in the laboratory.
4. Study of the developmental stages and life cycle of *Drosophila* from stock culture.
5. Study of different types of placenta.
6. Project report on *Drosophila* culture/chick embryo development.

Question Pattern:

Q1. Major Experiment 10

Preparation of temporary slides of any developmental stages of incubated chick embryo in the laboratory.

Or

Preparation of temporary slides of any developmental stages of cultured *Drosophila* in the laboratory.

Q2. Spotting any five slides from practical 1 and 2 (2X5=10)

Q3. Record – 02 marks

Q4. Viva – voce – 03 marks

SUGGESTED READINGS

1. Balinsky BI and Fabian BC (1981) An Introduction to Embryology. 5th Edition. International Thompson Computer Press.
2. Gilbert SF (2010) Developmental Biology. 9th Edition. Sinauer Associates, Inc., USA.
3. Kalthoff (2008) Analysis of Biological Development. 2nd Edition. McGraw-Hill, New York.
4. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.

Vth Sem

CORE COURSE: ZOOLOGY  
PAPER XII  
MOLECULAR BIOLOGY  
(CREDITS: THEORY-4, PRACTICALS-2)  
THEORY

LECTURES: 60

Marks 75

**Unit 1: Nucleic Acids and DNA Replication**

Watson and Crick model of DNA; DNA denaturation and renaturation; DNA topology - linking number and DNA topoisomerases; Cot curves; Structure of monocistronic and polycistronic gene; Structure of RNA, DNA Replication mechanism in prokaryotes and eukaryotes (Role of proteins and enzymes in replication; RNA priming; Replication of circular and linear ds-DNA and replication of telomeres).

**Unit 2: Transcription**

RNA polymerase and transcription Unit; Mechanism of transcription in prokaryotes and Eukaryotes; Synthesis of rRNA and mRNA; Transcription factors and regulation of transcription.

**Unit 3: Translation**

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

**Unit 4: Post Transcriptional Modifications and Processing of Eukaryotic RNA**

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing.

**Unit 5: Gene Regulation and Regulatory RNAs**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencers elements; Gene silencing, Genetic imprinting; Ribo-switches, RNA interference, miRNA and siRNA.

**PRACTICAL Marks 25**

1. Study of DNA replication using Photographs or slides and special cases, e.g., Polyteny using permanent slides of polytene chromosomes.
2. Preparation of liquid culture medium (LB) and raise culture of *E. coli*.
3. Estimation of the growth kinetics of *E. coli* by turbidity method.
4. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.
5. Demonstration of antibiotic sensitivity/resistance of *E. coli* to antibiotic pressure and interpretation of results.
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).
7. Quantitative estimation of RNA using Orcinol reaction.

**Question Pattern:**

Q1. Major Experiment

10

- a) Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).

or

Quantitative estimation of RNA using Orcinol reaction

Q2. Demonstration of spreading and streaking

05

Q3. Model submission on any one (DNA replication, transcription, protein synthesis, operon concept),

05

Q3. Record – 02 marks

Q4. Viva – voce – 03 marks

### SUGGESTED READINGS

1. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) *The World of the Cell*. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter (2008) *Molecular Biology of the Cell*, 4th Edition. Garland publishing Inc., New York.
3. Cooper GM and Hausman RE (2007) *The Cell: A Molecular Approach*. 4th Edition, ASM Press, USA.
4. De Robertis EDP and De Robertis EMF (2006) *Cell and Molecular Biology*. 8th Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp G (2010) *Cell and Molecular Biology: Concepts and Experiments*. 6th Edition. John Wiley and Sons. Inc., USA.
6. Mohanty PK (2000) *Illustrated Dictionary of Biology*. Kalyani Publishers, Ludhiana.

V<sup>th</sup> Sem

DISCIPLINE SPECIFIC ELECTIVE

DSE - I

ECONOMIC ZOOLOGY AND ANIMAL BEHAVIOUR

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

LECTURES: 60

Marks 75

**Unit 1: Bee-keeping and Bee Economy (Apiculture)**

Varieties of honey bees and Bee pasturage; Setting up an apiary: Langstroth's/Newton's hive, bee veil, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet; Diseases of honey bee, American and European Foulbrood, and their management; Honey extraction techniques; Physico-chemical analysis of honey; Other beneficial products from bee; Visit to an apiculture institute and honey processing Units.

**Unit 2: Silk and Silk Production (Sericulture)**

Different types of silk and silkworms in India; Rearing of *Bombyx mori*. Rearing racks and trays; disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons; Silkworm diseases: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis, and their management; Silkworm pests and parasites: Uzi fly, Dermestid beetles and their management; Silk reeling techniques and Quality assessment of silk fibre.

**Unit 3: Aquaculture I**

Brood stock management; Induced breeding of fish; Management of hatchery of fish; Management of nursery, rearing and stocking ponds; 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 4: Aquaculture II**

Prawn farming; Culture of crab; Pearl culture and Culture of air breathing fishes.

**Unit 5: Animal Behaviour**

Elementary idea on behavior, intelligence, pheromones, biological clocks.

\* Submission of report on any one field visits mentioned above. **PRACTICAL Marks 25**

1. Study of different types of bees (Queens, Drones and Worker bees).
2. Study of different types of silk moths.
3. Study of different types of pearls.
4. Study of different types of fish diseases.
5. Identification of different types of scales in fishes.
6. Study of different types of fins.
7. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)
8. Identification of various types of natural silks.

**Question Pattern for Practical**

1. Experiments from any one from practical no. 1-8 (any one) 10
2. Project Report submission 10
3. Record - 02 marks
4. Viva - voce - 03 marks

**SUGGESTED READINGS**

1. Dhyan Singh Bisht, Apiculture, ICAR Publication.
2. Dunham RA (2004) Aquaculture and Fisheries Biotechnology - Genetic Approaches. CABI publications, U.K.
3. Hafez ESE (1962) Reproduction in Farm Animals, Lea and Febiger Publishers.
4. Knobil E and Neill JD (2006) The Physiology of Reproduction. Vol. 2. Elsevier Publishers, USA.

5. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
6. Prost PJ (1962) Apiculture. Oxford and IBH, New Delhi.
7. Singh S. Beekeeping in India, Indian council of Agricultural Research, New De hi
8. Srivastava CBL (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.

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DISCIPLINE SPECIFIC ELECTIVE  
DSE -II  
BIOTECHNOLOGY: MICROBES TO ANIMALS  
(CREDITS: THEORY-4, PRACTICALS-2)  
THEORY

LECTURES: 60

Marks 75

**Unit 1: Introduction**

Concept and scope of Biotechnology; Importance of biotechnology and Application of biotechnology (medicine, agriculture, environment).

**Unit 2: Techniques in Gene Manipulation**

Restriction and modifying enzymes, Cloning vectors and Expression vectors, Transformation techniques, Identification of recombinants, Construction and screening of DNA libraries; Molecular analysis of DNA, RNA and proteins (*i.e.*, Southern, Northern and Western blotting), DNA sequencing (Sanger's method and automation), Polymerase Chain Reaction, Microarrays, DNA fingerprinting and RAPD.

**Unit 3: Microbes in Biotechnology**

Growth kinetics of microbes, Applications of microbes in industry (Concept of primary and secondary metabolites, Fermentation/Bioreactors, Downstream processing),

**Unit 4: Transgenic Animal**

Production of transgenic animals: Retroviral method, DNA microinjection method, embryonic stem cell method; Applications of transgenic animals; Brief idea on Knockout and knockin mice,

**Unit 5: Biotechnology and Human Welfare**

Animal cell technology: Concept of expressing cloned genes in mammalian cells; Recombinant DNA in health (Recombinant insulin), Gene therapy: *in vitro*, *in-vivo* and *ex-vivo*. Intellectual Property Rights.

**PRACTICAL Marks 25**

1. Isolation of genomic DNA from *E. coli* and analyze it using agarose gel electrophoresis.
2. Isolation of plasmid DNA (pUC 18/19) and analyse it using agarose gel electrophoresis.
3. Transformation of *E. coli* (pUC 18//19) and calculation of transformation efficiency.
4. Restriction digestion of lambda ( $\lambda$ ) DNA using *EcoRI* and *Hind III*.
5. DNA ligation (lambda DNA *EcoRI*/*Hind III* digested).
6. Construction of restriction digestion maps from data provided.
7. Study of Southern blot hybridization and PCR; Analysis of DNA fingerprinting (Dry Lab).
8. Project on Animal Cell Culture.

**Question Pattern:**

Q1. Major Experiment

12

a) . Study of Southern blot hybridization (Dry Lab)

or

b) PCR; Analysis of DNA fingerprinting (Dry Lab).

Q2. Visualization of DNA bands using agarose gel electrophoresis

08

Q3. Record - 02 marks

Q4. Viva - voce - 03 marks

### SUGGESTED READINGS

1. Beauchamp TL and Childress JF (2008) Principles of Biomedical Ethics, 6th Edition. Oxford University Press, USA.
2. Brown TA (1998) Molecular Biology Labfax II: Gene Cloning and DNA Analysis. 2nd Edition. Academic Press, USA.
3. Glick BR and Pasternak JJ and Patten CL (2009) Molecular Biotechnology - Principles and Applications of Recombinant DNA, 4th Edition. ASM press, Washington, USA.
4. Griffiths AJF, Miller JH, Suzuki DT, Lewontin RC and Gelbart WM (2009) An Introduction to Genetic Analysis. 9th Edition. W.H. Freeman and Co., USA.
5. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
6. Snustad DP and Simmons MJ (2009) Principles of Genetics. 5th Edition, John Wiley and Sons Inc., USA.
7. Watson JD, Myers RM, Caudy A and Witkowski JK (2007) Recombinant DNA - Genes and Genomes- A Short Course. 3rd Edition, Freeman and Co., USA.

VII<sup>th</sup> Sem

CORE COURSE: ZOOLOGY  
PAPER XIII  
IMMUNOLOGY  
(CREDITS: THEORY-4, PRACTICALS-2)  
THEORY

LECTURES: 60

Marks 75

**Unit 1: Immune System and Immunity**

Historical perspective of Immunology, Early theories of Immunology, Haematopoiesis, Cells and organs of the Immune system; Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity and Immune dysfunctions.

**Unit 2: Antigens**

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T - Cell epitopes.

**Unit 3: Immunoglobulins**

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays, Polyclonal sera, Monoclonal antibodies and Hybridoma technology.

**Unit 4: Major Histocompatibility Complex and Complement System**

Structure and functions of endogenous and exogenous pathway of antigen presentation; Components and pathways of complement activation.

**Unit 5: Cytokines, Hypersensitivity and Vaccines**

Properties and functions of cytokines; Cytokine-based therapies; Gell and Coombs' classification and Brief description of various types of hypersensitivities; Types of vaccines: Recombinant vaccines and DNA vaccines.

**PRACTICAL Marks 25**

1. Demonstration of lymphoid organs.
2. Ouchterlony's double immuno-diffusion method.
3. Determination of ABO blood group.
4. Preparation of single cell suspension of splenocytes from chick spleen, cell counting and viability test.
5. ELISA/ dot Elisa (using kit).
6. Principles, experimental set up and applications of immuno-electrophoresis, RIA, F.
7. Differential Cell Count of the blood film.
8. Extraction of plasma from whole blood.

**Question Pattern:**

- Q1. Major Experiment 12
- a) Differential Cell Count of the blood film
  - b) ELISA/ dot Elisa (using kit)
- Q2.a) Determination of ABO blood group 08
- b) Extraction of plasma from whole blood
- Q3. Record - 02 marks
- Q4. Viva - voce - 03 marks



### SUGGESTED READINGS

1. Abbas KA and Lichtman HA (2003) Cellular and Molecular Immunology. 5th Edition. Saunders Publication, Philadelphia.
2. David M, Jonathan B, David RB and Ivan R (2006) Immunology. 7th Edition. Elsevier Publication, USA .
3. Kindt TJ, Goldsby RA, Osborne BA and Kuby J (2006) Immunology. 6th Edition. W.H. Freeman and Company, New York.
4. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.

VIT Sem

**CORE COURSE: ZOOLOGY**  
**PAPER XIV**  
**EVOLUTIONARY BIOLOGY**  
**(CREDITS: THEORY-4, PRACTICALS-2)**  
**THEORY**

**LECTURES: 60**

**Marks 75**

**Unit 1: History of Life, theories of Evolution and Extinction**

Chemogeny, Biogeny, RNA World, Major Events in History of Life; Lamarckism; Darwinism; Neo-Darwinism; Background of extinction, Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail) and Role of extinction in evolution.

**Unit 2: Evidences of Evolution**

Fossils and its types; Dating of fossils, Phylogeny of horse and human; Molecular evidences (Globin gene families as an example) and Molecular clock concept.

**Unit 3: Processes of Evolutionary Change**

Organic variations; Isolating mechanisms; Natural selection (Industrial melanism, Pesticide/Antibiotic resistance); Types of natural selection (Directional, Stabilizing, Disruptive), Sexual Selection and Artificial selection.

**Unit 4: Principles of population genetics**

Concept of gene pool, Gene frequencies – equilibrium frequency (Hardy-Weinberg equilibrium), Shift in gene frequency without selection – Genetic drift, Mutation pressure and Gene flow and Shifts in gene frequencies with selection.

**Unit 5: Species Concept and Evolution above species level**

Biological concept of species (Advantages and Limitations); Sibling species, Polymorphic species, Polytypic species, Ring species; Modes of speciation (Allopatric, Sympatric); Macro-evolutionary Principles (Darwin's Finches); Convergence, Divergence and Parallelism.

**PRACTICAL Marks 25**

1. Study of fossil evidences from plaster cast models and pictures.
2. Study of homology and analogy from suitable specimens/ pictures.
3. Demonstration of changing allele frequencies with and without selection.
4. Construction of cladogram based on morphological characteristics.
5. Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip).
6. Interpretation of phylogenetic trees.

**Question Pattern:**

Q1. Major Experiment

12

- a) Study of fossil evidences from plaster cast models and pictures
- b) Study of homology and analogy from suitable specimens/ pictures

Q2.a) Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip). 08

- b) Interpretation of phylogenetic trees
- c) Demonstration of changing allele frequencies with and without selection

Q3. Record – 02 marks

Q4. Viva – voce – 03 marks

### SUGGESTED READINGS

1. Barton NH, Briggs DEG, Eisen JA, Goldstein DB and Patel NH (2007) Evolution. Cold Spring Harbour Laboratory Press.
2. Campbell NA and Reece JB (2011) Biology. 9th Edition. Pearson Education Inc., New York.
3. Douglas JF (1997) Evolutionary Biology. Sinauer Associates, USA.
4. Hall BK and Halgrimsson B (2008) Evolution. 4th Edition. Jones and Bartlett Publishers, USA.
5. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
6. Pevsner J (2009) Bioinformatics and Functional Genomics. 2nd Edition. Wiley-Blackwell, USA.
7. Ridley M (2004) Evolution. 3rd Edition. Blackwell Publishing, USA.

VIII<sup>th</sup> Sem

DISCIPLINE SPECIFIC ELECTIVE  
DSE -III  
MICROBIOLOGY  
(CREDITS: THEORY-4, PRACTICALS-2)  
THEORY

Marks 75

LECTURES: 60

- Unit 1: History of Microbiology; Microbial World – Characterization, Classification and identification of microbes.  
Unit 2: Prokaryotes: General morphology and classification of bacteria, their characters and economic importance; Gram-positive and Gram-negative bacteria.  
Unit 3: Eukaryotes: General morphology of Protista and Fungi – classification and economic importance.  
Unit 4: Viruses: structure, genome, replication cycle; Epidemiology of infectious diseases with reference of human hosts – Bacterial (Tuberculosis), Viral (Hepatitis), Protozoan (Amoebiasis) and Fungal (any one) disease.  
Unit 5: Microbe interactions-Immune Responses-Antibiotics and other chemotherapeutic agents; Applied microbiology in the fields of food, agriculture, industry and environment.

PRACTICAL Marks 25

1. Cleaning of glasswares, sterilisation principle and methods - moist heat - dry heat and filtration methods.
2. Media preparation: Liquid media, Solid media, Agar slants, Agar plates. Basal, enriched, selective media preparation - quality control of media, growth supporting properties, sterility check of media.
3. Pure culture techniques: Streak plate, pour plate and decimal dilution.
4. Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description and demonstration of pigment production.
5. Staining techniques: Smear preparation, simple staining, Gram's staining, Acid fast staining and staining for metachromatic granules.
6. Morphology of microorganisms.
7. Antibiotic sensitivity testing: Disc diffusion test - Quality control with standard strains
8. Physiology characteristics: IMViC test, H<sub>2</sub>S, Oxidase, catalase, urease test, Carbohydrate fermentation, Maintenance of pure culture, Paraffin method, Stab culture and maintenance of mold culture.

Question Pattern:

- Q1. Major Experiment 12
- a) Study of fossil evidences from plaster cast models and pictures
  - b) Study of homology and analogy from suitable specimens/ pictures
- Q2.a) Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip). 08
- b) Interpretation of phylogenetic trees
  - c) Demonstration of changing allele frequencies with and without selection
- Q3. Record – 02 marks
- Q4. Viva – voce – 03 marks

SUGGESTED READINGS

1. Ahsan J and Sinha SP (2010) A Hand book on Economic Zoology. S Chand, New Delhi.
2. Arora DR and Arora B (2001) Medical Parasitology. 2nd Edition. CBS Publications and Distributers.
3. Atwal AS (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, Ludhiana.
4. Dubey RC and Maheshwari DK (2013) A Textbook of Microbiology. S. Chand, New Delhi.
5. Dunham RA (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications.
6. Pelczar MJ, Chan ECS and Krieg NR (1993) Microbiology. 5th Edition, Tata McGraw Hill Publishing Co.Ltd.
7. Pradhan, S (1983) Insect Pests of Crops. National Book Trust of India, New Delhi.
8. Shukla, G.S. and Upadhyay, V.B. (2013) Economic Zoology. 5th Edition, Rastogi Publications, Meerut.

VII<sup>th</sup> Sem

**DISCIPLINE SPECIFIC ELECTIVE  
DSE -IV  
CREDITS : 6  
PROJECT WORK  
MARKS -100**

To undertake discipline related project work and submit a project report

Marks Distribution : Project Report - 70  
Seminar: 20  
Viva - Voce : 10