

GOVERNMENT COLLEGE (A) RAJAMAHENDRAVARAM
M.Sc., ZOOLOGY
SEMESTER-II 2024-25
CORE-4: GENETICS AND EVOLUTION

Learning Outcomes:

By the completion of this course, students will be able to:

- **Understand Mendelian inheritance**
- **Recall Mendel's laws**
- **Understand linkage and crossing over**
- **Gain knowledge on concepts of evolution and theories of evolution**
- **Understand speciation**

Principles of Inheritance

1.0. Mendel's Law of inheritance

1.1. Monohybrid cross – Principle of segregation; Dihybrid cross – Principle of independent assortment.

Extension to Mendelian Inheritance – Allelic interactions – Co-dominance, incomplete dominance, pleiotropism, multiple alleles (e.g., ABO blood group alleles in humans, Rh factor alleles in humans).

1.2. Genes to Phenotype – Inborn errors of metabolism; one gene-one enzyme hypothesis; human eye color; position effect variegation (eye color in *Drosophila*).

Unit II: Linkage and Crossing Over

1.1. Linkage and crossing over, Genetic mapping of chromosomes

1.2. Sex determination, sex-linked & sex-influenced traits, and sex differentiation

1.3. Genetic imprinting, karyotyping, Barr body identification

1.4. Human genome project

Unit III: Concepts of Evolution & Theories of Evolution

3.1. Natural selection by Darwin

3.2. Neo-Darwinism, Hardy-Weinberg law of genetic equilibrium, mutations, migration

3.3. Origin and evolution of primates and humans

Unit IV: Speciation

1.1. Genetics of speciation, phylogenetic and biological concepts of species

1.2. Models of speciation (Allopatric, Sympatric, and Parapatric). Patterns and mechanisms of reproductive isolation

1.3. Phylogenetic gradualism and punctuated equilibrium; Micro and macroevolution; Origin of higher categories

Suggested Reading Material:

1. Dobzhansky, T. *Genetics and the Origin of Species*, Surjeet Publication, Delhi
2. Dobzhansky, T., F.J. Ayala, G.L. Stebbins, and J.M. Valentine. *Evolution*, Surjeet Publication, Delhi
3. Futuyama, D.J. *Evolutionary Biology*, Sinauer Associates, Inc., Publishers, Sunderland
4. Hartl, D.L. *A Primer of Population Genetics*, Sinauer Associates, Inc., Massachusetts
5. Jha, A.P. *Genes and Evolution*, John Publication, New Delhi
6. King, M. *Species Evolution - The Role of Chromosomal Change*, The Cambridge University Press, Cambridge
7. Meierer, D.J. *Evolution and Genetics*, Oxford University Press, New York
8. Strikberger, M.W. *Evolution*, Jones and Bartlett Publishers, Boston London

GOVERNMENT COLLEGE (A) RAJAMAHENDRAVARAM
M.Sc. ZOOLOGY II SEMESTER

PRACTICAL SYLLABUS

ZOO201 - Genetics and Evolution Lab:

1. Examples for Monohybrid, Dihybrid cross, Co-dominance, Incomplete dominance
2. Multiple alleles (Sums for blood relations)
3. Karyotyping – Barr body identification
4. Hardy-Weinberg equilibrium
5. Models of speciation (Allopatric, Sympatric, and Parapatric)

GOVERNMENT COLLEGE (A) RAJAMAHENDRAVARAM
M.Sc., ZOOLOGY

SEMESTER-II (2024-25)

CORE-5: DEVELOPMENTAL BIOLOGY

Learning Outcomes:

By the completion of this course, the student will be able to:

- Gain knowledge of basic concepts in developmental biology
- Analyze the process of gametogenesis
- Understand gene regulation
- Generalize stem cell therapy

Unit-I: Scope of Developmental Biology

1. Scope and importance of developmental biology
2. Gametogenesis – spermatogenesis, oogenesis, vitellogenesis
3. Fertilization – Eggs, sperm, mechanism of fertilization, acrosomal formation, acrosomal reaction, chemical changes during fertilization in humans
4. Cleavage – Types, mechanism of cleavage, chemical changes during cleavages

Unit-II: Early Embryonic Development and Organogenesis

1. Blastula, Gastrula, Neurolation – Neural tube formation
2. Organogenesis – Mechanism of cellular differentiation (Ectoderm, Mesoderm, Endoderm) formation
3. Limb, Central Nervous system, heart, kidney, and eye formation

Unit-III: Gene Regulation

1. Gene regulation in development – Maternal genes, maternal and zygotic control during initiation of development
2. Ageing – Consequences, causes, control by genes, ageing of cells in vitro
3. Hormones as mediators of development. Ovarian luteinization and mammary gland differentiation
4. Role of pituitary hormones in development – FSH, LH, Oxytocin, Progesterone, Estrogen, Testosterone
5. Structure and physiology of the mammalian ovary, folliculogenesis, corpus luteum and its functions

Unit-IV: Stem Cell Technology

1. Stem cell technology – India's stem cell therapy
2. Animal cloning, IVF (test tube baby concept)
3. Potential applications of transgenic animals
4. Gene editing technology

GOVERNMENT COLLEGE (A) RAJAMAHENDRAVARAM
M.Sc. ZOOLOGY II SEMESTER

PRACTICAL SYLLABUS

Developmental Biology Lab:

1. Observation of types of eggs
2. Identification of different stages: Cleavage, Blastulation, Gastrulation
3. Slides – Mammalian heart, kidney, testis, ovary
4. Pregnancy test using a commercial kit

GOVERNMENT COLLEGE (A) RAJAMAHENDRAVARAM
M.Sc. ZOOLOGY

II SEMESTER (2024-2025)
CORE-6: IMMUNOLOGY

Learning Outcomes

By the completion of this course, the student will be able to:

- Gain knowledge of basic concepts of immunology.
- Differentiate between innate and acquired immunity.
- Understand the concept of antigen-antibody interaction.
- Generalize different hypersensitivity processes.

UNIT-I

Immunity

- Innate and acquired immunity, innate immune mechanisms, acute phase reactants, properties of acquired immunity.
- **Immunogens and Antigens** – Properties, factors governing immunogenicity, haptens, epitopes size, and identification.
- **Adjuvants** – Properties and mechanism of action.
- **Immunoglobulin** – Structure, isotypes, allotypes, and idiotypes. Functions of antibodies in relation to their structure.

UNIT-II

Antigen-Antibody Interactions

- Affinity and avidity of antibodies, bonus effect, classical precipitin reaction, antigen-binding site of antibodies, forces involved in antigen-antibody complex formation.
- **Lymphoid Tissue** – Primary and secondary lymphoid organs, structure, and cellular organization. Lymphocyte traffic.
- **Cells in Immune Response** – T cells, B cells, CD antigens, neutrophils, eosinophils, and natural killer cells.
- **Antigen Presentation** – Pathways of antigen processing and presentation of intracellular and extracellular antigens.

UNIT-III

Antibody Response

- Primary and secondary antibody response, antibody response to haptens, enumeration of antibody-forming cells, T-dependent and T-independent antigens.
- **Macrophages** – Role in immune response and activation.
- **Cell-Mediated Immunity** – Helper, cytotoxic, and suppressor T cells. In vivo and in vitro assays for the assessment of cell-mediated immunity.
- **Complement System** – Classical and alternative pathways of activation, regulation of complement activation, and its functions.
- **Antigen Receptors** – On T and B cells. Generation of receptor diversity.

UNIT-IV

Development of the Immune System

- T cell ontogeny in the thymus, thymic hormones, and cell development.

- **Tumor Immunology** – Immunity to tumors, tumor-specific antigens, and immunosurveillance.
- **Immunological Tests** – Immunodiffusion, immunoelectrophoresis, immunofluorescence, radioimmunoassay (RIA), and enzyme-linked immunosorbent assay (ELISA).

Suggested Reading Material

1. *Immunology and Immunopathology* by Stewart
2. *Cellular and Molecular Immunology* by Abul K. Abbas et al.
3. *Textbook of Immunology* by Barret
4. *Essential Immunology* by Roitt, Brostoff, Male (5th & 6th Editions)
5. *Immunology* by Kuby, Goldsby, Kindl, Osborne
6. *Immunobiology – The Immune System in Health and Disease* by Janeway and Travers
7. *Immunology – An Introduction* by Tizard
8. *Textbook of Immunology* by Unani and Benacerraf
9. *Fundamentals of Immunology* by Paul
10. *Immunology – A Short Course* by Benjaini, Sunshine, and Lesrowitz

GOVERNMENT COLLEGE (A) RAJAMAHENDRAVARAM

M.Sc. ZOOLOGY

II SEMESTER (2024-25)

CORE-6: IMMUNOLOGY

**Practical Syllabus
Immunology Lab:**

1. Western Blotting
2. Single Radial Immunodiffusion (SRID)
3. Double Immunodiffusion (DID)
4. Immunoelectrophoresis
5. Radioimmunoassay (RIA)
6. ELISA
7. Agglutination Test
8. Identification of histological slides of lymphoid tissue – spleen, thymus, lymph node, bone marrow

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

**M.Sc. Zoology II Semester
SEC-3: Quantitative Biology**

Learning Outcomes

By the completion of this course, students will:

- Gain knowledge of basic statistical concepts.
- Understand sampling techniques.
- Analyze the process of central tendency measures.
- Create and interpret various types of graphs.
- Comprehend fundamental computer concepts for data analysis.

Syllabus

UNIT-I

- Introduction – Scope and applications of statistics in biology.
- Sampling – Essentials, advantages, methods, and sampling errors.
- Frequency Distribution – Preparation of ordered, discrete, and continuous tables.
- Diagrammatic Presentation – Data representation using diagrams, graphs, and curves.
- Skewness and Kurtosis.

UNIT-II

1. Measures of Central Tendency – Mean, median, and mode.
2. Measures of Dispersion – Standard deviation, variance, and coefficient of variation.
3. Correlation.
4. Regression.

UNIT-III

1. Laws of Probability – Terminology and measurement.
2. Probability Distributions – Binomial, Poisson, and normal distributions.
3. Tests of Significance – Chi-square test, t-test.
4. Analysis of Variance (ANOVA).

UNIT-IV

1. Fundamentals of Computers – Introduction to computerized statistics in biology.
2. Computer-Aided Techniques – Data presentation, data analysis, and statistics.
3. Mathematical Modelling – Types, steps for building models.
4. Biological Models – Examples like snail shell growth and morphogenesis.

Additional Topics

- Matrices – Definition, scope, and applications.

Suggested Reading Material

1. **Batschelet, E.** *Introduction to Mathematics for Life Scientists*. Springer-Verlag.
2. **Jorgensen, S.E.** *Fundamentals of Ecological Modelling*. Elsevier.
3. **Swaritzman, G.L., and S.P.O. Kaluzny.** *Ecological Simulation Primer*. Macmillan.
4. **Lendren, D.** *Modeling in Behavioural Ecology*. Chapman & Hall.
5. **Sokal, R.R., & F.J. Rohlf.** *Biometry*. Freeman.
6. **Snedecor, G.W., & W.G. Cochran.** *Statistical Methods for Environmental Biologists*. Wiley.
7. **Murray, J.D.** *Mathematical Biology*. Springer-Verlag.
8. **Pielou, E.C.** *The Interpretation of Ecological Data*.

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

M.Sc. Zoology II Semester

ZOO207SEC-3: Quantitative Biology

1. Vectors and Matrices – Problems.
2. Sampling Techniques – Lottery method and random digits.
3. Frequency Distribution.
4. Graphical Presentation of data.
5. Measures of Central Tendency – Mean, median, and mode.
6. Measures of Dispersion – Standard deviation and coefficient of variation.
7. Probability Problems.
8. Coefficient of Correlation.
9. Circuit Diagram – Examples of models.
10. Ecological Modeling – Case study.

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

M.Sc. Zoology Semester 2024-26
SEC-5: Principles of Biotechnology

Learning Outcomes

By the completion of this course, students will:

- Gain knowledge of the basic concepts of biotechnology principles.
- Understand recombinant DNA technology.
- Explore the applications of PCR in biotechnology and genetic engineering.
- Develop employability skills for laboratory settings.

Syllabus

UNIT-I

1. **Concepts of Biotechnology** – Scope and importance; Biotechnology in India.
2. **Recombinant DNA Technology.**
3. **Gene Cloning** – Cloning and expression vectors, chimeric DNA.
4. **Gene Libraries** – Genomic libraries.

UNIT-II

1. **Polymerase Chain Reaction (PCR).**
2. **Gene Amplification** – Basic PCR and its modifications.
3. **Applications of PCR** – In biotechnology and genetic engineering.

UNIT-III

1. **Animal Cell and Tissue Culture** – Laboratory facilities, culture media.
2. **Procedures** – Primary culture, cell lines, cloning, tissue, and organ culture.
3. **Biotechnology in Medicine** – Animal and human healthcare.
4. **Genetic Counselling and Forensic Medicine.**

UNIT-IV

1. **Biotechnology and Environment** – Pollution control, environment, and energy conservation.
2. **Biodiversity and Conservation.**
3. **Biotechnology and Intellectual Property** – Intellectual Property Rights (IPR) and Intellectual Property Protection (IPP).
4. Property Protection (IPP).

Suggested Reading Material

1. Gupta, P.K. *Elements of Biotechnology.*
2. Singh, B.D. *Biotechnology.*
3. Balasubramanian. *Concepts in Biotechnology.*

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

M.Sc. Zoology Semester 2024-26

Practical Syllabus

Z406: Principles of Biotechnology Lab

1. Determination of DNA, RNA, glucose, proteins, and lipids.
2. Polyacrylamide gel electrophoresis (PAGE).
3. Southern Blotting and Northern Blotting.
4. PCR demonstration.