



Sri Y.N.College(Autonomous),Narsapur
(Affiliated to Adikavi Nannaya University, Rajamahendravaram)
Accredited by NAAC at 'A+' Grade (4th Cycle)
B.Sc.Honours in Biotechnology (Major)
First Semester – Course 1
INTRODUCTION TO CELL BIOLOGY AND GENETICS



Course Objectives

1. To introduce students to the structure and function of prokaryotic and eukaryotic cells.
2. To provide knowledge on cellular organelles and their roles in cell physiology.
3. To explain the principles of genetics, including Mendelian laws and chromosome organization.
4. To describe mutagenesis, DNA damage, and repair mechanisms.
5. To create awareness about the cell cycle, cancer biology, and cell signaling processes.

Learning Outcomes

After completing this course, students will be able to

1. Identify and describe the structure of different types of cells and their components.
2. Explain the functions of cell organelles and mechanisms of cell transport.
3. Apply Mendelian principles and recognize deviations in inheritance patterns.
4. Analyze causes of mutations and describe DNA repair mechanisms.

Compare normal and cancer cells, and explain the regulation of cell cycle and apoptosis.

Unit I

Cell as a basic unit of living organism; Cell wall Structure, chemical composition and function. Glycocalyx. Structure and Function of Cell membranes; Brief description of viral, bacterial, fungal, plant and animal cells.

Unit II

Sub-cellular organization of eukaryotic cell: Nucleus, nuclear envelope, Nucleolus; cytosol, endoplasmic reticulum, chloroplast, mitochondria, vacuoles, ribosomes, lysosome and golgi complex; phagocytosis, pinocytosis, exocytosis. Chromosomes: Morphology, Structural Organization.

Unit III

Mendel Experiments, Mendel Laws and Deviations: Incomplete Dominance and Co-dominance; Concept of multiple alleles; Hardy-weinberg Law, Monohybrid Cross Dihybrid Cross, Test Cross Back Cross.

Unit IV

Phenotype, Genotype, Sex Determination, Chromosomal theory of inheritance, Karyotyping, Pedigree analysis, genetic Disorders: Sickle Cell anaemia, Hemophilia, Cystic Fibrosis.

Unit V

Mutagenesis - Spontaneous and induced (Chemical and physical) mutations; Mutations- point mutations, frameshift mutations; Factors affecting DNA damage; Repair Mechanisms - Light induced repair, Excision repair and mismatch repair and SOS repair.

Reference books

- ❖ Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter - Molecular Biology of the Cell-Garland Science.
- ❖ Geoffrey M. Cooper and Robert E. Hausman The Cell: A Molecular Approach - ASM Press & Sinauer Associates.
- ❖ Gerald Karp-Cell and Molecular Biology: Concepts and Experiments John Wiley & Sons.
- ❖ De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology Saunders College Publishing.
- ❖ Snustad, D.P. and Simmons, M.J. Principles of Genetics - John Wiley & Sons.

- ❖ Gardner, E.J., Simmons, M.J. and Snustad, D.P. Principles of Genetics - John Wiley & Sons.
- ❖ Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. - Molecular Cell Biology - W.H. Freeman and Company.

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Units	Essay Questions	Short Answer Questions
Unit – I	2	1
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	2

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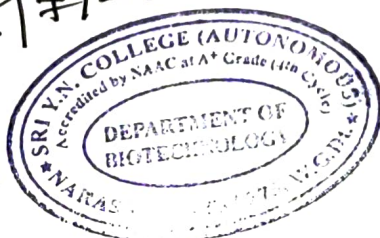
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Accredited by NAAC at 'A+' Grade (4th Cycle)



I B.Sc.Honours in Biotechnology (Major)

First Semester – Course 1

INTRODUCTION TO CELL BIOLOGY AND GENETICS

Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. Cell Wall
2. Vacuoles
3. Lysosome
4. Test cross
5. Codominance
6. Genotype
7. SOS repair
8. Frame shift mutations

Answer any FIVE questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

Section – II

9. Explain the structure and function of cell membrane
10. Write an essay on description of Plant and Animal cells.
11. Define chromosome. Describe the structural organization
12. Write an account on Endoplasmic reticulum and chloroplast.
13. Define Gene. Write an account on Dihybrid cross.

Section – III

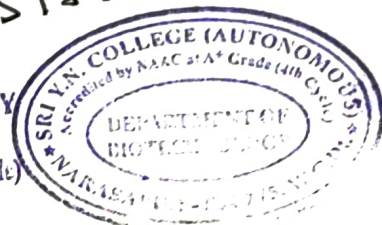
14. Describe the Hardy-Weinberg law.
15. Explain the chromosome theory of Inheritance.
16. Write an account on Pedigree analysis.
17. What is Mutation? Describe the types of mutations.
18. What are the factors affecting DNA damage.

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B.Sc.Honours in Biotechnology (Major)

First Semester – Course 1

INTRODUCTION TO CELL BIOLOGY AND GENETICS

Practical Component

1. Principle and utilization of microscope
2. Preparation of blood smear and observation of cells
3. Study of divisional stages in mitosis
4. Study of divisional stages in meiosis
5. Observation of differences between stained bacterial cells and cells in onion peels
6. Observation of permanent slides of bacterial, fungal, plant and animal cells
7. Problem solving in genetics
8. Human Karyotype analysis
9. Simple Mendelian traits in humans and pedigree analysis

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B.Sc.Honours in Biotechnology (Major)

First Semester – Course 2
BIOLOGICAL CHEMISTRY



Course Objectives

1. To introduce students to the structure and properties of nucleic acids and their biological significance.
2. To explain the chemistry and classification of carbohydrates, lipids, porphyrins, heme, and chlorophylls.
3. To provide knowledge on amino acids, protein structure, and conformational analysis.
4. To develop understanding of enzyme classification, kinetics, inhibition, and mechanisms of action.
5. To describe bioenergetics, ATP, and central metabolic pathways including glycolysis, TCA cycle, and oxidative phosphorylation.

Learning Outcomes

After completing this course, students will be able to

1. Describe the chemical structure and structural variations of nucleic acids.
2. Classify and explain the structures and functions of carbohydrates, lipids, and porphyrins.
3. Explain the properties and structural organization of proteins using the Ramachandran plot.
4. Analyze enzyme kinetics, substrate specificity, and different types of enzyme inhibition.

5. Understand the principles of bioenergetics and summarize major energy-yielding metabolic pathways.

UNIT I

Nucleic Acids: Chemical structure and base composition of nucleic acids (DNA and RNA). Chargaff's rules. Watson Crick Model (B-DNA), deviations from Watson-Crick model. Alternative forms of DNA (A-DNA and Z-DNA). Forces stabilizing nucleic acid structures, (hydrogen bonds and hydrophobic associations).

UNIT-II

Carbohydrates: Definition, classification, nomenclature of carbohydrates, structures of monosaccharides, disaccharides and polysaccharides. Concept and examples of heteropolysaccharides.

Lipid: Structure of saturated and unsaturated fatty acids, triglycerides, phospholipids.

UNIT III

Amino acids and Proteins: Structure of amino acids occurring in proteins, classification of amino acids (pH based, polarity based and nutrition based) physico-chemical properties of amino acids. Primary, Secondary, Tertiary & Quaternary structure of proteins.

UNIT IV

Enzymes: Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc. Classification and nomenclature of enzymes. Substrate Specificity (bond specificity, group specificity, absolute specificity, stereospecificity), lock and key and induced fit models. effect of substrate concentration, effect of enzyme concentration, effect of pH and temperature. Enzyme inhibition (reversible inhibition types competitive, uncompetitive and non-competitive).

UNIT V

Bioenergetics: Concept of free energy. Entropy, Enthalpy & Redox Potential, Glycolysis, Krebs cycle, Gluconeogenesis

Reference books

- ❖ Lehninger, A.L., Nelson, D.I. and Cox, M.M. Principles of Biochemistry - W.H. Freeman and Company.
- ❖ Voet, D. and Voet, J.G. Biochemistry John Wiley & Sons.
- ❖ Stryer, L. Biochemistry W.H. Freeman and Company.
- ❖ Satyanarayana, U. and Chakrapani, U. Biochemistry Elsevier/Books and Allied (Indian edition)
- ❖ Zubay. G. Biochemistry Wm. C. Brown Publishers.
- ❖ Garrett, R.H. and Grisham, C.M. Biochemistry Brooks/Cole, Cengage Learning.
- ❖ Conn, E.E. and Stumpf. P.K. Outlines of Biochemistry-John Wiley & Sons.

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Units	Essay Questions	Short Answer Questions
Unit - I	2	1
Unit - II	2	2
Unit - III	2	1
Unit - IV	2	2
Unit - V	2	1

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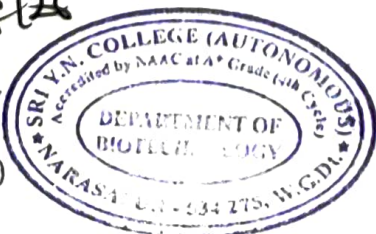
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I B.Sc.Honours in Biotechnology (Major)

**First Semester – Course 2
BIOLOGICAL CHEMISTRY**



Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. DNA
2. Monosaccharides
3. Ketones
4. Polarity
5. Activator
6. Redox
7. Uncompetitive inhibition
8. Phospholipids

Answer any FIVE questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

Section – II

9. Explain the Watson and Crick model of DNA
10. Write an essay on forces stabilizing nucleic acid structures.
11. Describe the nomenclature of Carbohydrates
12. What are the structures of fatty acids?
13. Write an essay on amino acids.

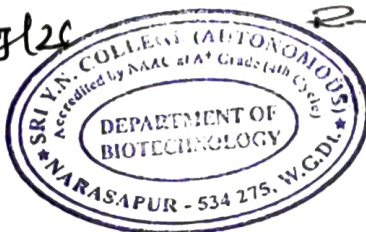
Section – III

14. Describe the structural organization of proteins.
15. Explain the induced fit theory.
16. Write an essay on classification and nomenclature of Enzymes.
17. What is Glycolysis? Explain the steps involved in Glycolysis.
18. Write an essay on gluconeogenesis.

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I B.Sc.Honours in Biotechnology (Major)

First Semester – Course 2
BIOLOGICAL CHEMISTRY



Practical Component

1. Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2. Calculation of molarity, normality, and molecular weight of compounds.
3. Qualitative analysis of carbohydrates (sugars)
4. Quantitative analysis of carbohydrates
5. Quantitative estimation of protein - Lowery method
6. Estimation of DNA by diphenylamine reagent
7. Estimation of RNA by orcinol reagent
8. Assay of protease activity
9. Preparation of starch from potato and its hydrolyzation by salivary amylase

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B.Sc.Honours in Biotechnology (Major)
Second Semester – Course 3
MICROBIOLOGY



Course Objectives

1. To introduce the history and development of microbiology along with contributions of key scientists.
2. To explain the principles and applications of different types of microscopy.
3. To study the structure, morphology, and special features of bacteria, including staining techniques.
4. To provide knowledge on microbial nutrition, growth, cultivation, and methods of microbial control.
5. To introduce viruses, their structure, replication, classification, and transmission with examples of human diseases.

Learning Outcomes

After completing this course, students will be able to

1. Summarize the historical contributions of Pasteur, Koch, and Jenner in microbiology.
2. Differentiate between light, phase contrast, dark field, fluorescent, and electron microscopy.
3. Describe bacterial morphology, cell structures, plasmids, endospores, and staining methods.
4. Identify nutritional requirements, growth phases, and apply sterilization and disinfection techniques.

5. Explain the structural organization, replication strategies, and transmission of viruses including modern examples.

UNIT 1

History, Development and Microscopy

History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner. Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance. Electron microscopy: Principle, ray diagram and applications, TEM and SEM, comparison between optical and electron. Microscope.

UNIT II

Bacteria: Bacterial morphology and subcellular structures, general morphology of bacteria, shapes and sizes, generalized diagram of typical bacterial cell. Slime layer and capsule. Cell wall of Gram+ve and Gram -ve cells.

General account of flagella and fimbriae. Chromatin material, plasmids; definition and kind of plasmids (conjugative and non-conjugative) F, R, and Col plasmids

Staining: Acidic, Basic and Neutral stains. Simple and Gram Staining. Acid fast staining. Flagella staining. Endospore staining.

Unit III

Microbial Nutrition: Basic nutritional requirements. Composition of Natural and Synthetic Media. Selective and Differential media, Enriched media, Enrichment media. Factors Affecting **Growth of Microbes:** pH, Temperature, Salinity. Classification of microorganisms based on nutrition and temperature.

UNIT IV

Microbial growth and control: Growth rate and generation time, details of growth curve and its phases. Measurement of growth. Pure cultures and cultural characteristics. Maintenance of pure culture. **Microbial Control:** Sterilization (Physical and chemical methods of sterilization), disinfection, sanitization, germicide, microbistasis, antiseptics and antimicrobials.

UNIT V

Viruses: General characteristics and Properties of Viruses, Classification of viruses on the basis of nucleic acids composition. Basic Structure of Lamda and M13 DNA Virus. **Viral Transmission:** Different modes (dengue, SARS-CoV-2) and their preventive measures.

Reference books

- ❖ Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. Microbiology-Tata McGraw-Hill Publishing Company.
- ❖ Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology-McGraw-Hill Higher Education.
- ❖ Cappuccino, J.G. and Sherman, N. Microbiology: A Laboratory Manual - Pearson Education.
- ❖ Willey, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott's Principles of Microbiology-McGraw-Hill.
- ❖ Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An Introduction - Pearson Education.
- ❖ Powar, C.B. and Dagainawala, H.F. General Microbiology-Himalaya Publishing House.
- ❖ Ananthanarayanan, R. and Paniker, C.K.J. Textbook of Microbiology - Universities Press (for medical aspects).

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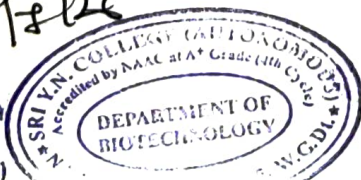
Units	Essay Questions	Short Answer Questions
Unit - I	2	2
Unit - II	2	2
Unit - III	2	1
Unit - IV	2	2
Unit - V	2	1

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B.Sc.Honours in Biotechnology (Major)

Second Semester – Course 3

MICROBIOLOGY



Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. Louis pasteur
2. TEM
3. Capsule
4. Gram staining
5. Selective media
6. Growth curve
7. microbistasis
8. SARS-COV-2

Answer any FIVE questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

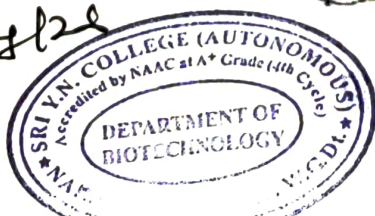
Section – II

9. Draw and explain Compound microscopy.
10. Differentiate between Optical and Electron microscopy.
11. What are the steps involved in Acid fast staining?
12. Explain Morphology and sub cellular structure of Bacteria.
13. What are the factors affecting microbial growth?

Section – III

14. What are the basic nutritional requirements of bacteria.
15. Explain about microbial growth and control.
16. What is Sterilization? Explain about types of Sterilization
17. Explain the basic structure of the following
 - a) Lambda
 - b) M₁₃ DNA Virus
18. What are the General characteristics of Viruses?

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B.Sc.Honours in Biotechnology (Major)

Second Semester – Course 3

MICROBIOLOGY



Practical Component

1. Cleaning and preparation of glassware
2. Observation of permanent slides using microscope
3. Preparation of nutrient agar medium for bacteria
4. Preparation of PDA medium for fungal culture
5. Sterilization techniques (autoclave, hot air oven, filter)
6. Isolation of bacteria from soil
7. Simple staining technique.
8. Differential staining technique
9. Microbial counting by Haemocytometer
10. Identification of different bacteria
11. Motility test by hanging drop
12. Biochemical identification of bacteria
13. Preparation of pure culture by slab, slant, streak culture

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B.Sc.Honours in Biotechnology (Major)
Second Semester – Course 4
BASIC IMMUNOLOGY



Course Objectives

1. To introduce the fundamentals of the immune system, immune cells, and immuneorgans.
2. To explain the structure, types, and diversity of antibodies and the nature of antigens.
3. To describe mechanisms of humoral and cell-mediated immunity, cytokines, and MHC molecules.
4. To provide knowledge about hypersensitivity, autoimmunity, vaccination, and different types of vaccines.
5. To familiarize students with immunological techniques and applications of monoclonal antibodies.

Learning Outcomes

After completing this course, students will be able to

1. Explain the organization of the immune system and differentiate innate and acquired immunity.
2. Describe antibody structure, types, and antigenic determinants.
3. Analyze mechanisms of humoral, cell-mediated, and NK cell-mediated immune responses.
4. Differentiate between types of hypersensitivity and explain the principles and applications of vaccination.
5. Apply knowledge of immunological techniques for antigen-antibody interactions and monoclonal antibody production.

UNIT I

Immune System: History and Scope of Immunology. Types of Immunity: Innate and Acquired. Cells of immune system: T cells, B cells. Organs of the Immune system: Bone marrow, spleen, thymus, MALT, lymph node.

UNIT II

Antibody and Antigen: Antibodies: Structure and Types of Antibodies (IgG, IgM, IgA, IgE, IgD). Monoclonal and Polyclonal antibodies. Antibody diversity. Antigens: Types of Antigens. Antigenicity (factors affecting antigenicity). Antigenic determinants adjuvants and haptens, epitopes.

UNIT III

Immunity: Humoral immunity. Cell-mediated immunity T Cell-mediated immunity, NK cell-mediated immunity, ADCC. Brief description of cytokines and interleukins. Major Histocompatibility Complex (MHC) Structure and functions of Class I and Class II MHC molecules.

UNIT IV

Hypersensitivity and Vaccination: General features of hypersensitivity, various types of hypersensitivity. Autoimmunity. Vaccination: Discovery, principles, and significance. Types of Vaccines Live, attenuated, killed, toxoids, recombinant-based (mRNA and Protein).

UNIT V

Immunological Techniques : Antigen-antibody reactions
Precipitation, agglutination, complement fixation, immunodiffusion Radial immune diffusion, RIA, immunoelectrophoresis, Hybridoma technology: Monoclonal antibodies and their applications.

Reference books

- ❖ Kuby, J. Immunology W.H. Freeman & Company.
- ❖ Abbas, A.K., Lichtman, A.H. and Pillai, S. Cellular and Molecular Immunology Elsevier.
- ❖ Roitt, L., Brostoff, J. and Male, D. Immunology Mosby Publications.
- ❖ Ananthanarayanan, R. and Paniker, C.K.J. Textbook of Microbiology - Universities
- ❖ Press (for immunology basics). Kindt, T.J., Goldsby, R.A. and Osborne, B.A. Kuby Immunology - W.H. Freeman.
- ❖ Delves, P.J., Martin, S.J., Burton, D.R. and Roitt, L.M. - Roitt's Essential Immunology - Wiley-Blackwell.

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Units	Essay Questions	Short Answer Questions
Unit - I	2	1
Unit - II	2	2
Unit - III	2	2
Unit - IV	2	1
Unit - V	2	2

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B.Sc.Honours in Biotechnology (Major)

Second Semester – Course 4

BASIC IMMUNOLOGY



Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any **FIVE** questions from the following.

5 X 4 = 20 M

1. B-cells
2. Adjuvants
3. Monoclonal antibodies
4. ADCC
5. Interleukins
6. Auto immunity
7. Agglutination
8. RIA

Answer any **FIVE** questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

Section – II

9. Explain about types of Immunity.
10. What are the primary lymphoid organs?
11. Draw and explain structure and types of antibodies
12. What are the factors affecting antigenicity?
13. Explain the following
 - a) Cell mediated immunity
 - b) T- cell mediated immunity

Section – III

14. Explain the structure and functions of MHC molecules.
15. Define hypersensitivity and explain its types
16. Discuss about different types of vaccine
17. What are the antigen-antibody reactions?
18. Explain principle and procedure of immunoelectrophoresis.

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Second Semester – Course 4

BASIC IMMUNOLOGY



Practical Component

1. Antigen-antibody reaction-determination of Blood group, Cross reactivity
2. Pregnancy test
3. Widal test
4. Ouchterlony immunodiffusion
5. Radial immuno diffusion
6. ELISA
7. Production of antibodies and their titration.

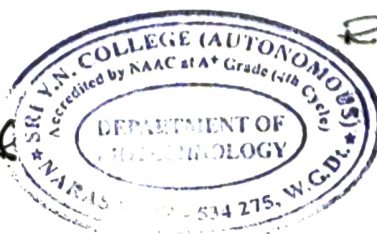
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THIRD SEMESTER
Course 5: BIOPHYSICAL TECHNIQUES

Course Objectives

1. To introduce the principles and applications of spectrophotometry in biological research.
2. To explain the theory, instrumentation, and uses of different types of chromatography.
3. To familiarize students with the principles and applications of electrophoresis techniques.
4. To provide knowledge about centrifugation methods, rotors, centrifuge types, and their applications.
5. To describe tracer techniques, radioactivity measurements, autoradiography, and the use of non-radioactive labels.

Learning Outcomes

After completing this course, students will be able to

1. Understand the principles of light absorption and apply UV-visible spectrophotometry.
2. Differentiate between various chromatographic techniques and apply them for biomolecule separation and analysis.
3. Perform and interpret results from gel electrophoresis, SDS-PAGE, isoelectric focusing, and related techniques.
4. Apply centrifugation methods for separation and analysis of cellular and molecular components.
5. Explain the principles of tracer techniques, radioactivity measurement, and non-radioactive labelling methods in biotechnology.

UNIT I

Spectrophotometry: Spectrum of light, absorption of electromagnetic radiations, Beer-Lambert's law: derivation and deviations, colorimeter, instrumentation of UV and visible spectrophotometry, applications of UV and visible spectrophotometry.

UNIT II

Chromatography: Principle, instrumentation and applications of paper chromatography, thin layer chromatography, affinity chromatography, high performance liquid chromatography (HPLC).

UNIT III

Electrophoresis: Migration of ions in electric field, factors affecting electrophoretic mobility, gel electrophoresis: types of gels, agarose gel electrophoresis, SDS-PAGE, isoelectric focusing.

UNIT IV

Centrifugation: Basic principles of centrifugation, types of rotors, types of centrifuges: clinical, high-speed and ultracentrifuges, **preparative centrifugation:** differential and density gradient centrifugation and their applications.

UNIT V

Tracer Techniques: Radioactive and stable isotopes, units of radioactivity, measurement of radioactivity: autoradiography, applications in biotechnology.

Blue Print

Units	Essay Questions	Short Answer Questions
Unit – I	2	1
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	2

Reference books

- ❖ Keith Wilson and John Walker – Principles and Techniques of Biochemistry and Molecular Biology – Cambridge University Press.
- ❖ R. K. Murray et al. – Harper's Illustrated Biochemistry – McGraw Hill (for basics of spectrophotometry and biochemistry techniques).
- ❖ David J. Holme and Hazel Peck – Analytical Biochemistry – Pearson Education.
- ❖ Boyer, R. – Modern Experimental Biochemistry – Pearson.
- ❖ Plummer, D.T. – An Introduction to Practical Biochemistry – Tata McGraw Hill.

- ❖ S. K. Sawhney and R. Singh – Introductory Practical Biochemistry – Narosa Publishing House.
- ❖ Ghosh, T.K. – Biophysical Chemistry – Books and Allied (for tracer techniques and centrifugation).

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THIRD SEMESTER

Course 5: BIOPHYSICAL TECHNIQUES

Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. electromagnetic spectrum.
2. Rf value and its significance.
3. applications of Affinity Chromatography.
4. SDS-PAGE
5. Isoelectric focusing
6. differential centrifugation.
7. Isotope
8. Radioactivity

Answer any FIVE questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

Section – II

9. Explain the principle, instrumentation of UV-Visible spectrophotometry.
10. Derive Beer–Lambert's law and explain its significance in quantitative analysis.
11. Describe the principle, instrumentation, procedure of Paper Chromatography with a neat diagram.
12. Describe the principle, instrumentation of High-Performance Liquid Chromatography (HPLC).
13. Define electrophoresis. Explain the principle and procedure for electrophoresis.

Section – III

14. Explain the principle, instrumentation, procedure of Agarose Gel Electrophoresis.
15. Describe the different types of rotors used in centrifugation.
16. Explain preparative centrifugation with neat labelled diagrams.
17. Define tracer techniques. Explain the principle of tracer techniques and discuss their significance in biological research.
18. Explain in detail about Autoradiography.

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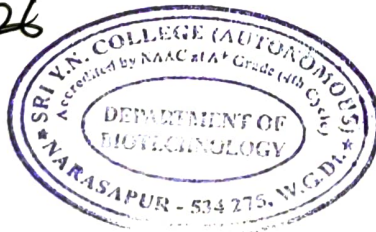
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THIRD SEMESTER

Course 5: BIOPHYSICAL TECHNIQUES

Practical Component

1. Separation of plant pigments and amino acids by paper chromatography
2. Separation of lipids of TLC
3. Quantification of DNA using Spectrophotometer
4. Quantification of RNA using Spectrophotometer
5. Agarose gel electrophoresis

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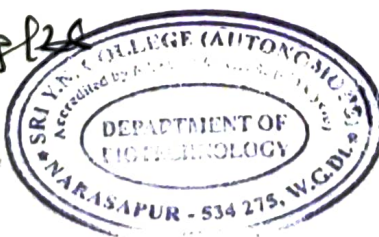
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THIRD SEMESTER

Course 6: BASIC MOLECULAR BIOLOGY



Course Objectives

1. To understand the experimental proof that DNA is the genetic material.
2. To study genome organization in prokaryotes and eukaryotes.
3. To explain the processes of DNA replication, transcription, and translation.
4. To understand the regulation of gene expression in prokaryotic and eukaryotic systems.
5. To develop a basic understanding of molecular mechanisms underlying heredity and protein synthesis.

Learning Outcomes

After completing this course, students will be able to

1. Describe experiments that established DNA as the genetic material.
2. Compare the genome structure of prokaryotes and eukaryotes.
3. Explain the mechanism of DNA replication, transcription, and translation.
4. Discuss the regulation of gene expression using operon models.
5. Apply knowledge of molecular biology to understand genetic processes in living organisms.

Unit - I

Genome Structure: Experiments to prove DNA as genetic material (Griffith experiment, Hershey- Chase experiment). **Genome Organization:** Prokaryotic and Eukaryotic genomes. Concept of Gene, Genome and Genome size

Unit - II

DNA Replication: Proof of semiconservative replication. Enzymes Involved in DNA Replication: DNA polymerase I, II and III, Helicases, Topoisomerases, single strand binding proteins, primase. Mechanism of DNA Replication (Prokaryotic and Eukaryotic).

Unit - III

Transcription: Basic features of transcription, the structure of prokaryotic RNA polymerases – Prokaryotic and Eukaryotic. Concept of core enzyme, hollo enzyme, and sigma factor. Concept of promoter – TATA Box, -10 and -35 sequences). Concept of Reverse Transcription.

Unit - IV

Translation: Genetic code: Features of genetic code, Structure of mRNA, brief structure of tRNA.the Wobble Hypothesis. Mechanism of Translation - Prokaryotic and Eukaryotic.

Unit - V

Gene Regulation: Clustered genes the operon concepts - Negative and positive control of the Lac Operon, Control of gene expression.

Blue Print

Units	Essay Questions	Short Answer Questions
Unit – I	2	2
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	1

Reference books

- ❖ Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. & Losick, R. (2017). *Molecular Biology of the Gene*. 7th Edition, Pearson Education.
- ❖ Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. & Martin, K. (2021). *Molecular Cell Biology*. 9th Edition, W.H. Freeman and Company.
- ❖ Krebs, J.E., Goldstein, E.S. & Kilpatrick, S.T. (2017). *Lewin's Genes XII*. Jones & Bartlett Learning.
- ❖ Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. & Walter, P. (2014). *Molecular Biology of the Cell*. 6th Edition, Garland Science.
- ❖ Primrose, S.B. & Twyman, R.M. (2006). *Principles of Gene Manipulation and Genomics*. 7th Edition, Blackwell Publishing.
- ❖ Berg, J.M., Tymoczko, J.L., Gatto, G.J. & Stryer, L. (2019). *Biochemistry*. 9th Edition, W.H. Freeman and Company.
- ❖ Weaver, R.F. (2018). *Molecular Biology*. 6th Edition, McGraw Hill Education.

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THIRD SEMESTER

Course 6: BASIC MOLECULAR BIOLOGY



Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. Concept of gene
2. Virulent
3. Topoisomerase
4. SSBP
5. Reverse transcription
6. Sigma factor
7. Wobble hypothesis
8. Clustered genes

Answer any FIVE questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

Section – II

9. Discuss the experimental evidence that established DNA as the genetic material, with special reference to the Griffith and Hershey–Chase experiments.
10. Describe the organization of the prokaryotic genome. Discuss its characteristic features and significance.
11. Explain how it proved the semiconservative mode of DNA replication.
12. Explain the structure, functions, of DNA Polymerase I, II, III, helicase, topoisomerase, primase.
13. Define transcription. Explain the basic features and mechanism of transcription in prokaryotes with a neat labeled diagram.

Section - III

14. Explain the structure and significance of the TATA box, -10 (Pribnow box), and -35 promoter sequences in transcription initiation.
15. Explain the genetic code. Discuss its important features with suitable examples.
16. Describe the mechanism of translation in both prokaryotes and eukaryotes.
17. Describe the structure and organization of the Lac operon.
18. Explain the concept of clustered genes and operons.

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THIRD SEMESTER

Course 6: BASIC MOLECULAR BIOLOGY



Practical Component

1. Effect of UV radiations on the growth of microorganisms.
2. Determination of absorption maxima of DNA and RNA and their quantification
3. Quantitative estimation of RNA
4. Quantitative estimation of DNA
5. Isolation of plasmid DNA from bacteria
6. Isolation of genomic DNA from *E. coli*
7. Isolation of DNA from sheep liver
8. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
9. Separation of DNA by Agarose gel Electrophoresis
10. Purity analysis of the Nucleic acids

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THIRD SEMESTER

COURSE 7: GENETIC ENGINEERING



Course Objectives

1. To introduce the principles, scope, and applications of genetic engineering.
2. To study molecular tools such as enzymes, cloning vectors, and transformation methods.
3. To understand hybridization techniques, PCR, and their applications in research.
4. To learn strategies for construction of genomic/cDNA libraries and protein expression.
5. To explore advanced genetic manipulation techniques such as CRISPR, site-directed mutagenesis, and next-generation sequencing.

Learning Outcomes

After completion of this course, students will be able to

1. Explain the history, scope, and tools used in genetic engineering.
2. Describe cloning vectors and transformation techniques in bacteria, yeast, plants, and animals.
3. Apply hybridization and PCR techniques for molecular analysis.
4. Construct and analyze genomic and cDNA libraries for gene studies.
5. Evaluate modern techniques such as CRISPR-Cas9, gene silencing, and next-generation sequencing.

UNIT –I

History, scope, and recent developments in Genetic Engineering. Molecular tools in genetic engineering – Restriction enzymes: Endonucleases and Exonucleases. DNA Modifying enzymes. Ligation (cohesive-end and blunt-end ligation), use of

linkers and adaptors. Guidelines and strategies in plant and animal genetic engineering.

UNIT –II

Cloning vectors: Definition, properties and types. Plasmid vectors – pUC19 and pBR322. Phage vectors – λ (lambda). Cosmid vectors, shuttle vectors, and expression vectors. YAC vectors (*Saccharomyces cerevisiae* as a model) Bacterial transformation.

UNIT –III

Hybridization techniques: Probes (radioactive and non-radioactive) and their labelling. Southern blotting and Northern blotting – principles and applications. Polymerase Chain Reaction (PCR): Principle, types of PCR, and applications.

UNIT –IV

Construction of genomic and cDNA libraries. Vector engineering – role of promoters. Strategies for protein overexpression in bacteria, yeast, insects, plants.

UNIT –V

Chromosome engineering and targeted gene replacement. Manipulation of gene regulation and gene silencing. DNA sequencing method – Maxam-Gilbert (chemical method).

Blue Prints

Units	Essay Questions	Short Answer Questions
Unit – I	2	2
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	1

Reference books

1. Brown, T.A. (2016). Gene Cloning and DNA Analysis: An Introduction. 7th Edition, Wiley-Blackwell.
2. Primrose, S.B. & Twyman, R.M. (2006). Principles of Gene Manipulation and Genomics. 7th Edition, Blackwell Publishing.

3. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. & Losick, R. (2017). Molecular Biology of the Gene. 7th Edition, Pearson Education.
4. Glick, B.R., Pasternak, J.J. & Patten, C.L. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 4th Edition, ASM Press.
5. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. & Walter, P. (2014). Molecular Biology of the Cell. 6th Edition, Garland Science.
6. Weaver, R.F. (2018). Molecular Biology. 6th Edition, McGraw Hill Education.
7. Channarayappa, C. (2014). Molecular Biotechnology: Principles and Practices. Universities Press, India.

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THIRD SEMESTER
COURSE 7: GENETIC ENGINEERING

Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. Adapters
2. Ligation
3. Shuttle vectors
4. YAC
5. PCR
6. Probe
7. RNAi
8. Mutagenesis

Answer any FIVE questions choosing at least two questions from Section II and Section III

5 X 8 = 40 M

Section – II

9. Explain the principles and applications of Genetic Engineering in modern biotechnology.
10. Describe the different molecular tools used in Genetic Engineering.
11. Compare pBR322 and pUC19 with respect to their structure, selectable markers, cloning sites, and applications.
12. Define cloning vectors. Discuss the different types of cloning vectors used in recombinant DNA technology.
13. Describe in detail about Southern blotting and applications.

Section – III

14. Discuss nucleic acid hybridization techniques.
15. Explain the construction of a cDNA library.
16. Define genomic. Explain the construction of genomic libraries.
17. Explain targeted gene replacement. Describe the methods, and applications in biotechnology and medicine.
18. Describe the Maxam–Gilbert DNA sequencing and applications.

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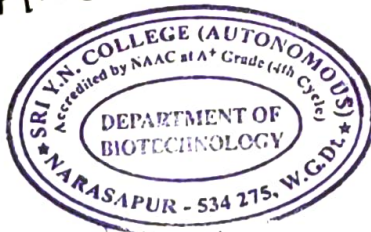
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THIRD SEMESTER COURSE 7: GENETIC ENGINEERING

Practical Component

1. Problem solving related to restriction enzymes sites in Genetic engineering.
2. Transformation in Bacteria using plasmid
3. Restriction digestion of DNA and its electrophoretic separation.
4. Ligation of DNA molecules and their testing using electrophoresis.
5. Activity of DNAase and RNAse on DNA and RNA.
6. Isolation of Plasmid DNA
7. Demonstration of PCR

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B.Sc. Honours in Biotechnology (Major)
Fourth Semester

Course -8: Bioinformatics, Biostatistics & Bioethics



Course Objectives

1. To introduce the scope of bioinformatics and its role in biological research.
2. To provide knowledge of genomics, proteomics, and systems biology concepts.
3. To familiarize students with databases, BLAST, drug design, and phylogenetic tools.
4. To train students in statistical methods for data collection, analysis, and interpretation.
5. To create awareness about bioethics, biosafety, and intellectual property rights in biotechnology.

Learning Outcomes

After successful completion of this course, students will be able to

1. Explain the fundamentals of bioinformatics and its applications.
2. Use biological databases, BLAST, and computational methods in biotechnology research.
3. Apply statistical tools like central tendency, probability, and hypothesis testing.
4. Perform tests such as t-test, ANOVA, chi-square, correlation, and regression for biological data.
5. Demonstrate understanding of bioethical issues, biosafety practices, and intellectual property rights.

Unit – I
Scope of computers in biological research. Introduction to Bioinformatics: definition, nature and scope of bioinformatics. Bioinformatics versus computational biology. Concept of genomics and proteomics. Branches of Bioinformatics.

Unit – II
Basic concepts of systems biology. Types of databases and their applications in biotechnology. Sequence similarity search using BLAST. Overview of computer-aided drug design.

Unit – III
Data collection and measurement of central tendency (mean, median and mode). Dispersion (standard error and standard deviation). Probability

Unit – IV
Population and sampling, test of significance, and test of hypothesis. Student t-test for small samples. ANOVA and chi-square test for analysis. Correlation.

Unit – V
Bioethics in human and animal experimentation, cloning and stem cell research. Animal rights and welfare. Biosafety -Introduction to biological safety cabinets and biosafety levels. Intellectual Property Rights (IPRs).

Blue Print

Units	Essay Questions	Short Answer Questions
Unit – I	2	1
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	2

Reference Books

1. Mount, D.W. (2004). Bioinformatics: Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press.

2. Lesk, A.M. (2017). Introduction to Bioinformatics. 5th Edition, Oxford University Press.
3. Rastogi, S.C., Mendiratta, N. & Rastogi, P. (2019). Bioinformatics: Methods and Applications. 5th Edition, PHI Learning Pvt. Ltd.
4. Gupta, S.P. (2012). Statistical Methods. 43rd Edition, Sultan Chand & Sons.
5. Bailey, N.T.J. (1995). Statistical Methods in Biology. 3rd Edition, Cambridge University Press.
6. Beauchamp, T.L. & Walters, L. (2008). Contemporary Issues in Bioethics. 7th Edition, Cengage Learning.
7. Singh, B.D. (2012). Biotechnology: Expanding Horizons. Kalyani Publishers.

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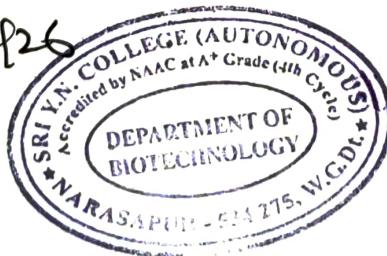
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II B.Sc. Honours in Biotechnology (Major)
Fourth Semester – Course 8
BIOINFORMATICS, BIOSTATISTICS & BIOETHICS

Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. Bioinformatics
2. BLAST
3. Databases
4. Mode
5. Data collection
6. Sampling
7. Biosafety
8. Cloning

Answer any FIVE questions choosing at least two questions from Section II and Section III
5 X 8 = 40 M

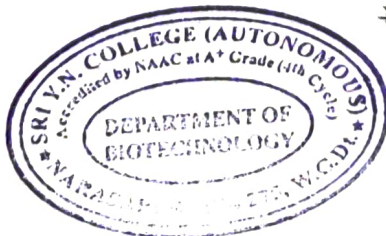
Section – II

9. What are the branches of Bioinformatics
10. Write the concepts of Genomics and Proteomics
11. Describe the basic concepts of system biology
12. Explain the overview of computer aided drug design
13. What is Probability and explain it.

Section – III

14. Describe the measure of dispersion with examples.
15. What is ANOVA? Derive it.
16. Explain the correlation with examples.
17. Elaborate the intellectual property rights (IPR)
18. Explain the cloning and stem cell research.

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B.Sc. Honours in Biotechnology (Major)

Fourth Semester

Course -8: Bioinformatics, Biostatistics & Bioethics



Practical Component

1. Mean, Median, Mode
2. Standard deviation, Standard error
3. Testing of hypotheses regarding population mean
4. Testing of hypotheses about the difference between population means
5. Chi-square test
6. Testing of Correlation Coefficient
7. Fitting of simple linear regression
8. ANOVA
9. Sequence retrieval (protein and gene) from NCBI
10. Similarity search using BLASTN, BLASTP
11. Structure download (protein and DNA) from PDB

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B.Sc. Honours in Biotechnology (Major)

Fourth Semester

Course -9: Basics of Plant Biotechnology



Course Objectives

1. To understand the principles of plant tissue culture and its applications.
2. To study specialized tissue culture techniques such as micropropagation, haploid culture, and protoplast fusion.
3. To learn different methods of genetic transformation in plants.
4. To explore the development and applications of transgenic plants.
5. To examine the use of plant biotechnology in production of valuable compounds, biofuels, and in sustainable agriculture, along with ethical and biosafety considerations.

Learning Outcomes

After completing this course, students will be able to

1. Explain the basic principles of plant tissue culture and its significance.
2. Apply micropropagation, haploid culture, and protoplast fusion techniques in plant improvement.
3. Differentiate between direct and indirect methods of plant genetic transformation.
4. Analyze the role of transgenic plants in agriculture, health, and environment.
5. Discuss applications of plant biotechnology in molecular farming, biofuels, biocontrol, and biofertilizers, and evaluate related ethical and biosafety issues.

Unit I

Plant Tissue Culture: Principles of plant tissue culture. Totipotency, differentiation, dedifferentiation, redifferentiation. Sterilization techniques, Types of culture media and composition of MS medium. Callus culture.

Unit II

Specialized Plant Tissue Culture Techniques: Micropropagation and its applications. Haploid culture – anther culture, doubled haploids and their applications. Protoplast culture and fusion – somatic hybridization, cybrids. Cryopreservation and germplasm conservation

Unit III

Plant Genetic Transformation Methods: Direct gene transfer methods – particle bombardment, electroporation, microinjection. Indirect Gene Transfer Method - *Agrobacterium tumefaciens*, *Agrobacterium*-mediated gene transfer.

Unit IV

Transgenic Plants and Applications: Transgenic plants for insect resistance (Bt crops). Transgenic plants for herbicide tolerance. Transgenic plants for disease resistance and stress tolerance. GMO Foods, Ecological impact of transgenic plants

Unit V

Applications of Plant Biotechnology: Therapeutic proteins, Edible vaccines, biofortification, and molecular farming. Phytochemical products from plants- Secondary Metabolites (Alkaloids, Flavonoids, Terpenoids). Ethical issues and biosafety regulations in Plant biotechnology

Blue Print

Units	Essay Questions	Short Answer Questions
Unit – I	2	1
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	2

Reference books

1. Bhojwani, S.S. & Razdan, M.K. (1996). Plant Tissue Culture: Theory and Practice. Elsevier.

2. Gamborg, O.L. & Phillips, G.C. (1995). Plant Cell, Tissue and Organ Culture: Fundamental Methods. Springer.
3. Chawla, H.S. (2009). Introduction to Plant Biotechnology. 3rd Edition, Oxford & IBH Publishing.
4. Slater, A., Scott, N. & Fowler, M. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. 2nd Edition, Oxford University Press.
5. Singh, B.D. (2015). Biotechnology: Expanding Horizons. Kalyani Publishers.
6. Glick, B.R., Pasternak, J.J. & Patten, C.L. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 4th Edition, ASM Press.
7. Razdan, M.K. (2003). Introduction to Plant Tissue Culture. Science Publishers.

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Sri Y.N. College (Autonomous)
Narasapur - 534 275
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Sri Y.N.College(Autonomous),Narsapur
(Affiliated to Adikavi Nannaya University, Rajamahendravaram)
Accredited by NAAC at 'A+' Grade (4th Cycle)
II B.Sc. Honours in Biotechnology (Major)
Fourth Semester – Course 9
BASICS OF PLANT BIOTECHNOLOGY



Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any **FIVE** questions from the following.

5 X 4 = 20 M

1. Totipotency
2. Cybrids
3. Protoplast
4. Electroporation
5. Particle bombardment
6. GMO
7. Terpenoids
8. Ethical issues

Answer any **FIVE** questions choosing at least two questions from Section II and Section III
5 X 8 = 40 M

Section – II

9. What is Tissue Culture? Explain it.
10. Explain the Sterilization?
11. Define Haploid. Describe the Anther culture with neat labeled diagrams.
12. Write an account on Cryopreservation and germ plasm conservation.
13. Discuss the direct gene transfer methods.

Section – III

14. Describe the agrobacterium tumefaciens and agrobacterium mediated gene transfer.
15. Explain the transgenic plants for insect resistance
16. Write an essay on ecological impact of transgenic plants.
17. Describe the biosafety regulations in plant biotechnology
18. What are the applications of plant biotechnology.

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S. Sri Lakshmi

S. S. Suresh



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B.Sc. Honours in Biotechnology (Major)

Fourth Semester

Course -9: Basics of Plant Biotechnology

Practical Component

1. Plant culture media and composition of MS media
2. Raising of aseptic seedlings
3. Induction of callus from different explants
4. Plant propagation through Tissue culture (shoot tip and Nodal culture)
5. Establishing a plant cell culture (both in solid and liquid media)
6. Suspension cell culture

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Rambabu

W. S. S.

P. Sri Lakshmi

A. S.

R. Arthina

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B.Sc. Honours in Biotechnology (Major)
Fourth Semester

Course –10: Basics of Animal Biotechnology



Course Objectives

1. To provide knowledge about the scope, importance, and laboratory requirements for animal cell culture.
2. To introduce students to various animal cell culture techniques and their applications.
3. To understand the role of stem cells and tissue engineering in regenerative medicine and organ culture.
4. To study transgenic animal production methods, cloning, and reproductive biotechnologies.
5. To explore applications of animal biotechnology in molecular farming, pharmaceuticals, and disease models, while addressing ethical and biosafety issues.

Learning Outcomes

After completing this course, students will be able to

1. Explain the principles of animal cell culture, media composition, and growth requirements.
2. Perform and differentiate between primary, secondary, continuous, and suspension cell cultures, including preservation and contamination control.
3. Analyze the applications of stem cells, scaffolds, and bioreactors in tissue engineering.
4. Describe the production of transgenic animals, animal cloning techniques, and reproductive biotechnology methods.

5. Evaluate the applications of animal biotechnology in health, pharmaceuticals, livestock improvement, and discuss related ethical and biosafety concerns.

Unit I

Animal Cell Culture: Scope and importance of animal biotechnology. Laboratory organization and Equipment required. Composition and Types of Animal Cell Culture Media (BSS). Role of carbon dioxide, serum, and growth factors in cell culture. Application of antibiotics and growth supplements

Unit II

Cell Culture Techniques: Primary culture, secondary culture, continuous cell lines, and suspension cultures. Sub-culturing. Contamination in cell culture and control measures, cryopreservation methods

Unit III

Stem Cells and Tissue Engineering: Embryonic and adult stem cell culture and its application. Bioreactors for large-scale animal cell culture

Unit IV

Transgenic Technology: Transgenic animal production methods – microinjection, viral vectors. Animal cloning techniques – nuclear transfer, case studies (e.g., Dolly). In vitro fertilization in livestock. Gene targeting, gene silencing, and knock-out techniques

Unit V

Applications of Animal Biotechnology: Molecular Farming: Hormone production in livestock. Role of animal models in disease diagnosis and treatment. Ethical and biosafety issues in animal biotechnology.

Blue Print

Units	Essay Questions	Short Answer Questions
Unit – I	2	1
Unit – II	2	2
Unit – III	2	2
Unit – IV	2	1
Unit - V	2	2

Reference books

1. Freshney, R.I. (2015). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 7th Edition, Wiley-Blackwell.
2. Masters, J.R.W. (2000). Animal Cell Culture: Practical Approach. 3rd Edition, Oxford University Press.
3. Butler, M. (2004). Animal Cell Culture and Technology. 2nd Edition, Taylor & Francis.
4. Davis, J.M. (2011). Animal Cell Culture: Essential Methods. Wiley-Blackwell.
5. Glick, B.R., Pasternak, J.J. & Patten, C.L. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 4th Edition, ASM Press.
6. Singh, B.D. (2015). Biotechnology: Expanding Horizons. Kalyani Publishers.
7. Portner, R. (2007). Animal Cell Biotechnology: Methods and Protocols. Humana Press.

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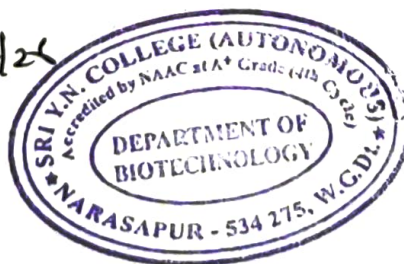
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II B.Sc. Honours in Biotechnology (Major)

Fourth Semester – Course 10

BASICS OF ANIMAL BIOTECHNOLOGY

Time: 3Hrs

Max. Marks: 60 M

Section – I

Answer any FIVE questions from the following.

5 X 4 = 20 M

1. Serum
2. Cell culture
3. Cell lines
4. Stem cells
5. Embryo
6. Dolly
7. Hormone
8. Livestock

Answer any FIVE questions choosing at least two questions from Section II and Section III
5 X 8 = 40 M

Section – II

9. What are the application of antibiotics and Growth supplements.
10. Write the scope and importance of animal Biotechnology
11. Write an essay on cryopreservation methods
12. What are the cell culture techniques.
13. Write an essay on bioreactors for large scale animal cell culture

Section – III

14. Describe the embryonic and adult stem cell culture
15. Write an essay on invitro fertilization with diagrams.
16. Explain the gene silencing and knock out techniques.
17. Discuss the role of animal models in disease diagnosis and treatment
18. What are applications of animal biotechnology.

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II B.Sc. Honours in Biotechnology (Major)

Fourth Semester

Course -10: Basics of Animal Biotechnology

Practical Component

1. Cell count by haemocytometer.
2. Establishing primary cell culture of chicken embryo fibroblasts.
3. Animal tissue culture- maintenance of established cell lines.
4. Animal tissue culture- virus cultivation.
5. Estimation of cell viability by dye exclusion (Trypan blue).

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P.S.

R. Arthinaaya

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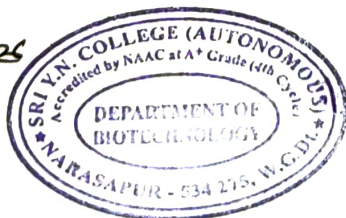
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