SHRI GNANAMBICA DEGREE COLLEGE: MADANAPALLE

(AUTONOMOUS)

BIOTECHNOLOGY

COURSE-5: PLANT AND ANIMAL BIOTECHNOLOGY

SEMESTER III

(W.E.F. 2025-2026)

Program: B.Sc. Biotechnology Honors

Hours per week: 4 **Credits: 3**

COURSE OUTCOMES (COS)

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

Unit I – Plant Tissue Culture Techniques & Secondary Metabolites Production

CO1: Understand and apply the principles and techniques of plant tissue culture and analyze their role in the production of secondary metabolites and large-scale applications.

Unit II – Transgenesis and Molecular Markers

CO2: Explain plant genetic transformation technologies, transgenic crops, and molecular marker systems with reference to their applications in biotechnology and agriculture.

Unit III – Animal Tissue Culture Techniques

CO3: Demonstrate knowledge of mammalian cell culture techniques, including culture conditions, maintenance, testing, and advanced monitoring using AI tools.

Unit IV – Transgenic Animals & Gene Therapy

CO4: Evaluate the use of transgenic animals in research and therapeutics, and interpret concepts and implications of gene therapy including mRNA-based technologies.

Unit V – Bioethics, Biosafety and IPR

CO5: Discuss ethical, safety, and intellectual property aspects in biotechnology research and development, using historical and current case studies.

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SYLLABUS

Unit – I Plant tissue culture techniques & secondary metabolites production

1. Totipotency, media preparation – nutrients and plant hormones; sterilization techniques; establishment of cultures – callus culture, cell suspension culture
2. Applications of tissue culture-micro propagation; Somatic embryogenesis
3. synthetic seed production; protoplast culture and somatic hybridization - applications. Cryopreservation, Plant secondary metabolites- concept and their importance.
4. **Use of Bioreactors for Large-Scale Production of Secondary Metabolites – Enhances commercial viability of in vitro plant-based compounds.**

Unit – II Transgenesis and Molecular markers

1. Plant transformation technology—Agrobacterium-mediated Gene transfer (Ti plasmid), hairy root features of Ri plasmid, Transgenic plants as bioreactors.
2. Herbicide resistance – glyphosate, Insect resistance- Bt cotton
3. Molecular markers - RAPD, RFLP and DNA fingerprinting-principles and applications.

Case Study: Development of Golden Rice

Illustrates the creation of a transgenic rice variety fortified with provitamin A, addressing malnutrition in developing countries through metabolic engineering.

Unit – III Animal tissue culture techniques

1. cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines, stem cell cultures;
2. Tests: cell viability and cytotoxicity, Cryopreservation.
3. Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.
4. **Use of Artificial Intelligence in Cell Culture Monitoring – AI assists in optimizing conditions and detecting contamination.**

Unit – IV Transgenic animals & Gene Therapy

1. Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin, somatostatin vaccines), IVF

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2. Concept of Gene therapy,
3. Concept of transgenic animals – Merits and demerits -Ethical issues in animal biotechnology
4. **mRNA-based Gene Therapy Applications**

   Justification: Inspired by COVID-19 mRNA vaccine success, mRNA technologies are now being rapidly applied in gene therapy and animal biotechnology to deliver therapeutic proteins.

Unit V Bioethics, Biosafety and IPR

1. Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare.
2. Bio safety-introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GLP,GMP
3. Introduction to IP-Types of IP: patents, trademarks & copyright

Case Study: He Jiankui and the CRISPR Baby Controversy

A landmark event in bioethics where gene-edited babies were born in China, sparking global debate on regulation, ethics, and governance in biotechnology.

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COURSE 5: PLANT AND ANIMAL BIOTECHNOLOGY

- PRACTICALS

Practical **Credits: 1** **2 hrs/week**

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
7. Cell count by hemocytometer.
8. Establishing primary cell culture of chicken embryo fibroblasts.
9. Animal tissue culture –maintenance of established cell lines.
10. Animal tissue culture –virus cultivation.
11. Estimation of cell viability by dye exclusion (Trypan blue).

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(W.E.F.2025-2026)

Program: B.Sc. Biotechnology Honors

Question Paper Blue Print

Time : 3 Hrs **Max Marks: 70**

(Draw diagrams wherever necessary)

I. Answer any Four Questions 4 X 5 =20

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....

II. Answer all the questions 5 X 10 = 50

1. (A).....

   Or

   (B).....
2. (A).....

   Or

   (B).....
3. (A).....

   Or

   (B).....
4. (A).....

   Or

   (B).....
5. (A).....

   Or

   (B).....

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Model Question Paper

Time : 3 Hrs **Max Marks: 70**

(Draw diagrams wherever necessary)

I. Answer any Four Questions 4 X 5 =20

1. Totipotency
2. Plant Secondary metabolites
3. RAPD & RFLP
4. Cryopreservation
5. Gene Therapy
6. Biosafety Cabinets
7. Ethical issues in animal biotechnology
8. Merits and demerits of Transgenic animals

II. Answer all the questions 5 X 10 = 50

1. (A) Callus Culture

   Or

   (B) Protoplast Culture
2. (A) Insect resistance plants with one example

   Or

   (B) Agrobacterium mediated gene transfer
3. (A) Briefly discuss Primary, Secondary cultures, Cell lines and stem cells culture

   Or

   (B) Transfection methods
4. (A) Production of Insulin

   Or

   (B) IVF
5. (A) Biosafety levels, GLP & GMP

   Or

   (B) Types of Intellectual Property rights

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