DISCIPLINE SPECIFIC CORE COURSE – 20

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biotechnology (BS-DSC-801)	**4**	**2**		**2**	Class XII with Biology	**NA**

Learning Objectives

The objective of the course is to expose students to the basic principles and applications of biotechnology. It will also teach them the basics of animal and plant tissue culture and various methods of gene transfer for the generation of transgenics. The course will also provide an understanding of the applications of biotechnology in medicine, forensics, archaeology and agriculture.

2.1 Course Learning Outcomes

The students after completing this course will be able to:

- Understand animal and plant tissue culture along with their applications
- Gain knowledge about methods of gene transfer in biotechnology
- Appreciate the use of biotechnology in medicine
- Gain insight into other industrial applications of biotechnology
- Become aware of the impact of biotechnology on agriculture

2.2 Course Contents

Theory

Credits: 2 **Total Hours: 30**

Unit I: Methods in animal and plant biotechnology **No. of hours: 08**

Introduction to cell and tissue culture; Overview of Reproductive Animal Biotechnology and livestock improvements: *artificial* insemination, embryo transfer, in-vitro fertilization, somatic cell nuclear transfer (Dolly the sheep). Methods of gene transfer: viral mediated gene transfer, direct gene transfer using PEG, micro injection, electroporation, microprojectile (biolistics) method, liposome mediated DNA delivery. Fermentation technology and upscaling to industrial production, Production of recombinant enzymes for use in industries.

Unit II: Medical Biotechnology **No. of hours: 07**

Production of recombinant pharmaceuticals: insulin, factor VIII, human growth hormones, erythropoietin. Recombinant Vaccines. Pharming—recombinant protein from live animals and plants. Gene therapy: Gene therapy for inherited diseases and cancer with suitable examples. The ethical issues related to gene therapy.

Unit III: Agricultural Biotechnology **No. of hours: 08**

The gene addition approach to plant genetic engineering: plants that make their own insecticides, Herbicide resistant crops. Gene subtraction: Antisense RNA and the engineering of fruit ripening in tomato, other examples of the use of antisense RNA in plant genetic engineering. Overview of plants as biofactories: plant based vaccines, plantibodies and biopharmaceuticals. Safety and ethical concerns of genetically modified plants, Preparation of fermented food products and beverages. Single cell proteins..

Unit IV: Environmental Biotechnology **No. of hours: 07**

Concept of ecosystem structure and function and importance of microbial ecology in Environmental Biotechnology. Functions of various microbial groups relevant to environmental systems, including waste treatment and resource recovery. Cooperation between different microbial species for enhanced biodegradation, Bio detoxification, Bioremediation Technologies, Biogeochemistry, and Bio hydrometallurgy. Microbial interaction with plastics, antibiotics and others emerging pollutants. Microbially Enhanced Phosphorus and Nitrogen Removal. Microbially Enhanced Oil Recovery; Microbial role in Carbon Storage and Capture (sequestration, conversion to useful biopolymers, etc.). Treatment of wastewater (Municipal treatment plant) and sewage. Bioremediation and Biodegradation.

2.3 Practical

Credit: 2 **Total Hours: 60**

1. Plant tissue culture
2. Restriction Fragment Length Polymorphism (RFLP) profiling of genetically modified plants.
3. Extraction of DNA from buccal swab.
4. Presentation of research papers.
5. Virtual lab for bioreactors
6. Educational trip to industrial plants/fermentation units
7. Case studies of the use of DNA profiling for kinship analysis
8. Designing of antisense RNA against polygalacturonase (*in silico*)
9. Group discussion on Archaeogenetics—using DNA to study human prehistory

ESSENTIAL READINGS

- Brown, T. A. (2016) Gene Cloning and DNA Analysis: An Introduction, (7th ed.). Wiley-Blackwell Publishing (Oxford, UK); ISBN: 978-1-119-07256-0
- Glick, B.R., Pasternak, J.J., Patten, C. L. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA (4th ed.). ASM Press (Washington DC); ISBN: 978-1-55581-498-4.
- Primrose, S.B., and Twyman, (2006) Principles of Gene Manipulation and Genomics (7th ed.), R. M. Blackwell Publishing (Oxford, UK) ISBN:13: 978-1-4051-3544-3.
- Buchann (2015). Biochemistry and Molecular Biology of plants. (2nd ed.). I K International. ISBN-10: 8188237116, ISBN- 978047 07 14218
- Willey, J., Sherwood, L., Woolverton, C. (2017). Prescott's Microbiology (10th ed.). McGraw Hill international. ISBN 13: 9781259657573.

SUGGESTED READINGS:

- Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 6th Edition.
- Roberta H. Smith. (2013) Plant Tissue Culture: *Techniques and Experiments*. 3rd edition. Academic Press. ISBN: 978-0-12-415920-4
- Adrian Slater, Nigel Scott and Mark Fowler. (2003) Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press
- Verma, A. S. and Singh, A. (2014). Animal Biotechnology. Academic Press, Elsevier, USA.
- Microbial Biotechnology, Glazer et al, 2nd edition, 2007, Cambridge University Press

3. Teaching Learning Process and Assessment Methods:

Facilitating the Achievement of Course Learning Outcomes**

Unit No.	**Course Learning Outcomes**	**Teaching and Learning Activity**	**Assessment Tasks**
I	Students will be introduced to the animal cell and tissue culture. They will gain insight into various methods of livestock improvements. They will also understand about different methods of gene transfer in animal and plant biotechnology. They will gain insight into fermentation technology and upscaling.	Teaching will be conducted both through black board mode and power point presentation mode. Discussions will be conducted on various recent methodologies in biotechnology.	Students will be given questions that are application based and require analytical skills. Quizzes will be held to gauge their conceptual understanding.
II	Students will be introduced to various applications of biotechnology in medicine. Students shall gain insight into gene therapy, pharming, recombinant vaccines and pharmaceuticals.	Classical chalk and board teaching, oral discussions and powerpoint presentations whenever needed.	Students shall be asked to make power-point presentations on latest advances in applications of biotechnology in medicine. Open book tests will be held to promote self-learning. Practical related oral questions will be asked.

III	Understand the applications of biotechnology in agriculture. Gain knowledge about the insecticides, Herbicide resistant crops. Understand about Antisense RNA and the engineering of fruit ripening in tomato, They shall learn about plants as biofactories and genetically modified plants	Teaching will be conducted both through black board mode and power point presentation mode. Practical knowledge used field visits shall be imparted.	Regular class question-answer sessions. Students will be asked to prepare PowerPoint presentations Internal assessment tests will be conducted. Discussions using case studies will be conducted.
IV	Students shall be introduced to various methods of preparation of fermented food products and beverages. They shall gain knowledge about Single cell proteins, Treatment of wastewater Bioremediation, biodegradation and recombinant enzymes.	Teaching will be conducted through black board and power point presentation. Useful video clips will be shown for better clarity.	Regular oral evaluation will be done. Internal assessment tests will be conducted

(Assessment tasks enlisted here are indicative in nature)**

4. Keywords: Biotechnology, gene transfer, livestock improvements, animal and plant tissue culture, gene therapy, recombinant vaccine, pharming, genetically modified plants, fermentation, bioremediation.