SYLLABI AND SCHEME OF EXAMINATIONS FOR MINOR COURSES FOR UNDER GRADUATE PROGRAMS (SINGLE MAJOR) MULTIDISCIPLINARY PROGRAMS)

(Based on Curriculum and Credit Framework for UG Programs under NEP)

WITH EFFECT FROM THE SESSION 2024-25

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

SYLLABI AND SCHEME OF EXAMINATIONS FOR MINOR COURSES FOR

UNDER GRADUATE SINGLE MAJOR/MULTIDISCIPLINARY PROGRAMS/ SINGLE MAJOR PROGRAM AFTER 2nd SEMESTER OF MULTIDISCIPLINARY PROGRAM

Minor Courses (MIC)/ Minor (Vocational) Course MIC(VOC)	TYPE OF PROGRAM				Credits Distribution			Total Credits	Workload			Total Work load	Marks				
	SINGLE MAJOR PROGRAM	MULTIDISCIPLINARY PROGRAM / SINGLE MAJOR PROGRAM AFTER 2nd SEMESTER OF MULTIDISCIPLINARY PROGRAM	Nomenclature of Course	Course Code	L	T	P		L	T	P		Theory		Practical		Total Marks
	SEMESTER	SEMESTER											Internal	External	Internal	External	
MIC 1 @ 4 credits	1	1	Basics in Biotechnology	24CBT401MI01	4	0	0	4	4	0	0	4	30	70	-	-	100
MIC 2 @ 4 credits	2	3	Principles of Gene Manipulation	24CBT402MI01	4	0	0	4	4	0	0	4	30	70	-	-	100
MIC 3 @ 4 credits	3	6	Principles and Applications of Agriculture Biotechnology	25CBT403MI01	4	0	0	4	4	0	0	4	30	70	-	-	100
MIC 4 (VOC) @ 4 credits	4	4	Biotechniques	25CBT404MV01	4	0	0	4	4	0	0	4	30	70	-	-	100
MIC 5 (VOC) @ 4 credits	5	5	IPR, Biosafety and Bioethics	26CBT405MV01	4	0	0	4	4	0	0	4	30	70	-	-	100
MIC 6 (VOC) @ 4 credits	6	6	Bioentrepreneurship	26CBT406MV01	4	0	0	4	4	0	0	4	30	70	-	-	100
MIC 7 (VOC) @ 4 credits	7	7															
MIC 8 (VOC) @ 4 credits	8	8															

L: Lecture; T: Tutorial; P: Practical

Note:

1. The Syllabi and Scheme of Examinations (SOE) for Minor (Vocational) Courses for UG Semester 7 and Semester 8 will be same as applicable for Vocational Course in Post Graduate semester 1 and semester 2 respectively.
2. Course coding of Minor courses for Single Major Programs will be applicable for Multidisciplinary Programs/ Multidisciplinary Programs after 2nd semester irrespective of their offering in any semester.
3. The student who select any Minor Course (MIC) of any discipline in first semester should study the Minor courses (MIC) in the same discipline in the subsequent semesters. However, while exercising the option for choosing Minor Vocational Course MIC (VOC), the student may opt the discipline either related to the discipline of Minor Course or the discipline of Major Course or any other discipline as per his/her choice.

Syllabi for Basics in Biotechnology

Semester 1

Session: 2024-25

Name of Program	Not to be filled	**Program Code**	Not to be filled
Name of the Course	Basics in Biotechnology	**Course Code**	24CBT401MI01
Hours per Week	4	**Credits**	(L: 4 T: 0 P: 0)
Maximum Marks	100 (70EA+30IA)	**Time of Examinations**	3 hours

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO 1: Provide students with a comprehensive understanding of the field of biotechnology, including its historical background, scope, and significance.
CLO 2: Students will understand the fundamental concepts in biology, chemistry, and related disciplines that form the foundation of biotechnology.
CLO 3: Students will understand necessary skills required in biotechnology research settings.
CLO4: Explore real-world applications of biotechnology in various sectors, such as medicine, agriculture, industrial biotechnology, and environmental biotechnology.

Unit 1: Introduction to biotechnology – an interdisciplinary pursuit; Main areas of application of biotechnology; Biotechnology research in India and biotechnology in context of developing world; Public perception of biotechnological products

Unit 2: Brief account of immunotechnology: Immune system (immune cells, types of immunity and general structure of immunoglobulins), hybridoma technology and monoclonal antibodies. *In vitro* fertilization and embryo transfer technology in brief.

Unit 3: Introduction of genetic engineering: Gene and genomes, proteins and proteome, history and overview of genetic manipulations, DNA fingerprinting and forensic analysis.

Unit 4: Environmental Biotechnology: An overview, scope and market of biological control of environment. Brief account on bioremediation and waste treatment biotechnology.

References:

1. Basic Laboratory Methods for Biotechnology: Textbook and Laboratory Reference by Lisa A. Seidman, Cynthia J. Moore, Jeanette Mowery, 2021
2. A Textbook of Biotechnology by RC Dubey, S Chand & Company Limited, 2022
3. A Comprehensive Training Guide for the Biotechnology Industry by Syed Imtiaz Haider, Anika Ashtok, CRC Press, 2009.
4. Principles of Gene Manipulation and Genomics by Sandy B. Primrose, Richard Twyman, Wiley, 2013.
5. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Bernard R. Glick, Jack J. Pasternak, ASM Press, 1998.
6. Selected articles from journals, and case studies

Syllabi for Principles of Gene Manipulation

Semester II

Session: 2024-25

Name of Program	**Not to be filled**	**Program Code**	**Not to be filled**
Name of the Course	**Principles of Gene Manipulation**	**Course Code**	**24CBT402MI01**
Hours per Week	**4**	**Credits**	**(L: 4 T: 0 P: 0)**
Maximum Marks	**100 (70EA+30IA)**	**Time of Examinations**	**3 hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Students will be introduced to the fundamental principles of molecular biology, and genetic engineering providing a solid theoretical foundation for understanding gene manipulation techniques.

CLO 2: Students will explore the molecular tools commonly used in genetic manipulation.

CLO 3: Students will be familiarize with genetic manipulation techniques

CLO4: Students will explore the diverse applications of gene manipulation techniques in various fields, including biotechnology, medicine, agriculture, and environmental science.

Unit 1: Genetic Engineering: Introduction and scope of genetic engineering, Milestones in genetic engineering, Purification of total cell DNA, plasmid DNA and Yield analysis

Unit 2: Nucleic Acid Modifying Enzymes: DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Methylase, Reverse transcriptase, Restriction endonucleases, Ligases.

Unit 3: Gene Recombination and Gene Transfer: Construction of recombinant DNA, Preparation of competent cells, Transformation, Gene transfer using plasmids.

Unit 4: Application of Genetic Engineering: Genetic engineering in animals, Genetic engineering in plants, Therapeutic products produced by Genetic engineering, human hormones, immune modulators and vaccines, DNA fingerprinting, Gene therapy.

References:

1. Genetic Engineering Fundamentals: An Introduction to Principles and Applications by John Kammermeyer, CRC Press, 2017.
2. Introduction to Genetic Engineering by RK Sahoo, Notion Press Media Pvt Ltd, 2021
3. Current Protocols Essential Laboratory Techniques by Emily A. Wiley, Sean R. Gallagher, Wiley, 2012.
4. Gene Cloning and DNA Analysis: An Introduction by TA Brown, Wiley, 2020.
5. Molecular Cloning: A Laboratory Manual by Michael R. Green and Joseph Sambrook, Cold Spring Harbor Laboratory Press, 2012.
6. Genetics and Genetic Engineering by Tomas Cannon, Edtech, 2018.
7. Basic Biotechnology by Colin Ratledge, Bjorn Kristiansen, Cambridge University Press, 2017.
8. Selected articles from journals, and case studies.

Syllabi for Principles and Applications of Agriculture Biotechnology

Semester III

Session: 2024-25

Name of Program	**Not to be filled**	**Program Code**	**Not to be filled**
Name of the Course	**Principles and Applications of Agriculture Biotechnology**	**Course Code**	**25CBT403MI01**
Hours per Week	**4**	**Credits**	**(L: 4 T: 0 P: 0)**
Maximum Marks	**100 (70EA+30IA)**	**Time of Examinations**	**3 hours**

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Provide students with a comprehensive understanding of the principles, concepts, and historical development of agricultural biotechnology.

CLO 2: Introduce students to the principles and techniques of genetic engineering as applied to agriculture, including gene cloning, genetic modification of crops for improved traits.

CLO 3: Familiarize students with the biotechnological tools and techniques commonly used in agricultural biotechnology research and development.

CLO4: Explore the applications of biotechnology in crop improvement.

Unit 1: Gene Cloning and DNA Analysis, Methods in Molecular Cloning, Transformation of DNA, Microinjection, eletroporation, biolistic method (gene gun), liposome, Agrobacterium mediated Gene Delivery.

Unit 2: Development of transgenics for abiotic & biotic stress tolerance, Herbicide resistant crops (roundup ready crops), Biopesticides, Overview of RNA silencing, CRISPR-Cas9.

Unit 3: Genetically modified Crops: safety, risks and public concerns: GM foods-merits and demerits, Safety tests on commercial GM crops. Environmental and Safety concerns of GM crops. The Terminator Technology.

Unit 4: Genetic and Molecular basis of Heterosis and Apomixis and their significance, Mutations and polyploidy in crop improvement, Overview of Molecular Markers and their applications. Biotechnology applications in crop improvement.

References:

1. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology, CRC Press, USA
2. Agricultural biotechnology, 1st edition, (2008) Rawat H, Oxford Book Co, India.
3. Agro-biotechnology and plant tissue culture, Bhojwani SS, Soh WY, Oxford & IBH Publication, India
4. Agricultural biotechnology, (2005), Kumar HD, Daya Publ House, India
5. Plant molecular breeding, (2009) Newbury HJ, John Wiley and Sons., USA.
6. Plant tissue culture and molecular markers: their role in improving crop productivity (2009) Kumar A, Shekhawat NS, IK International.
7. Biotechnology (2010) Das HK, 4th Edition, Wiley India Pvt. Limited, India
8. Genetically modified foods: safety, risks and public concerns (2013) Bawa AS and Kumar A, J Food Sci Technol. 50(6): 1035–1046.

Biotechniques

Semester IV

Session: 2024-25

Name of Program	Not to be filled	**Program Code**	Not to be filled
Name of the Course	Biotechniques	**Course Code**	25CBT404MV01
Hours per Week	4	**Credits**	(L: 4 T: 0 P: 0)
Maximum Marks	100 (70EA+30IA)	**Time of Examinations**	3 hours

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Students will demonstrate proficiency in a variety of laboratory techniques essential for biotechnology research.

CLO 2: Students will grasp the fundamental principles of molecular biology underlying biotechnological techniques.

CLO 3: Students will acquire skills in gene cloning, genetic engineering, and gene expression.

CLO4: Students will acquire skills about the basic fundamentals of data analysis and interpretation

Unit 1: Introduction: Overview of laboratory equipment and safety protocols, Introduction to basic laboratory techniques and procedures, Laboratory demonstration: Pipetting, solution preparation, and sterile techniques.

Unit 2: DNA extraction methods, Principles and applications of polymerase chain reaction (PCR) & RT-PCR, Gel electrophoresis and nucleic acid visualization, Real-time PCR, Cloning techniques: Restriction digestion, ligation, and transformation.

Unit 3: Analytical Techniques: Basics of spectrophotometry and fluorometry, SDS-PAGE, Western blotting and immunodetection, Mass spectrometry and other proteomics techniques.

Unit 4: Data Analysis and Interpretation: Statistical analysis of experimental data, Bioinformatics tools for sequence and data analysis, Interpretation of experimental results and troubleshooting.

References:

1. Current Protocols Essential Laboratory Techniques by Emily A. Wiley, Sean R. Gallagher, Wiley, 2012.
2. Gene Cloning and DNA Analysis: An Introduction by TA Brown, Wiley, 2020.
3. Molecular Cloning: A Laboratory Manual by Michael R. Green and Joseph Sambrook, Cold Spring Harbor Laboratory Press, 2012.
4. The Polymerase Chain Reaction by Francois Ferre, Kary B. Mullis, Richard A. Gibbs, Birkhäuser Boston, 2012.
5. PCR Topics: Usage of Polymerase Chain Reaction in Genetic and Infectious Diseases by Arndt Rolfs, Hermann C. Schumacher, Peter Marx, Springer Berlin Heidelberg, 2013.
6. Real-time PCR by M Tevfik Dorak, Taylor & Francis, 2007.
7. Spectrophotometry and Spectrofluorimetry: A Practical Approach by Mike Gore, Oxford University Press, UK, 2000.
8. Selected articles from journals, and case studies.
9. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, Cambridge.

IPR, Biosafety and Bioethics

Semester V

Session: 2024-25

Name of Program	Not to be filled	**Program Code**	Not to be filled
Name of the Course	IPR, Biosafety and Bioethics	**Course Code**	**26CBT405MV01**
Hours per Week	4	**Credits**	(L: 4 T: 0 P: 0)
Maximum Marks	100 (70EA+30IA)	**Time of Examinations**	3 hours

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Students should understand the principles of intellectual property rights (IPR) as they relate to biotechnological innovations

CLO 2: Students should be able to identify and analyze social and ethical issues arising from biotechnological advancements.

CLO 3: Students should be proficient in Biosafety and Biosecurity and data integrity practices in biotechnology.

CLO4: Students will demonstrate a clear understanding of IPR, Biosafety and Bioethics relevant to Biotechnology.

Unit 1: Intellectual Property Rights, Patents and Copyrights: Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances. GMO, Human genome and IPR, Substantive Patent Law Treaty (SPLT), World patent.

Unit 2: Social and ethical issues: Social and ethical issues in Biotechnology- cloning, human cloning, gene therapy, GMOs, clinical trials, AI in Biotechnology, Ethical committee functions- animal and human ethics committee.

Unit 3: Bio-safety and Biosecurity: Definition, Requirements, Biosafety laboratories-BSL-1, BSL-2, BSL-3, BSL-4, Biohazards, Biosafety concerns of genetically modified organisms (GMOs), GLP, GMP and FDA, IBSC (Institutional Biosafety Committee)

Unit 4: Data management and safety; Lab notebooks, Experimental data record keeping, raw data management, Publication ethics, Plagiarism, Clinical data collection and management, Informed consent.

References:

1. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology by Padma Nambisan Elsevier Science, 2017.
2. Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology by Sibi G, I.K. International Publishing House Pvt. Limited, 2020.
3. Peter Dabrock, Jochen Taupitz , Jens Ried (Editor) Trust in Biobanking: Dealing with Ethical, Legal and Social Issues in an Emerging Field of Biotechnology. Springer, 2012.
4. Robert A. Bohrer, A Guide to Biotechnology Law and Business, Carolina Academic Press, 2007.
5. Richard Sherlock & JD Morrey, Ethical Issues in Biotechnology, 2002.
6. Selected articles from journals, and case studies.

Bioentrepreneurship

Semester VI

Session: 2024-25

Name of Program	Not to be filled	**Program Code**	Not to be filled
Name of the Course	Bioentrepreneurship	**Course Code**	26CBT406MV01
Hours per Week	4	**Credits**	(L: 4 T: 0 P: 0)
Maximum Marks	100 (70EA+30IA)	**Time of Examinations**	3 hours

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Students will demonstrate an understanding of the fundamentals of entrepreneurship within the biotechnology industry, including key concepts, trends, and challenges.

CLO 2: Students will be able to identify and evaluate opportunities for biotechnology ventures.

CLO 3: Students will demonstrate knowledge of intellectual property rights and strategies for protecting biotechnology innovations

CLO4: Students will understand the regulatory landscape for biotechnology products and ethical dilemmas in biotechnology entrepreneurship.

Unit 1: Introduction to Bioentrepreneurship: Overview of biotechnology industry landscape, Characteristics of successful biotechnology entrepreneurs, Case studies of notable biotechnology startups. Biotechnology Startups- BIRAC, Incubation centres.

Unit 2: Opportunity Identification and Assessment: Identifying market needs and opportunities in biotechnology, Market analysis and validation techniques, Evaluating feasibility and scalability of biotechnology ventures, Sustainable business practices in biotechnology entrepreneurship.

Unit 3: Intellectual Property Management: Basics of intellectual property rights (patents, trademarks, copyrights), Strategies for protecting biotechnology innovations, Licensing and technology transfer in biotechnology.

Unit 4: Regulatory and Ethical Considerations: Regulatory landscape for biotechnology products (FDA, EPA, etc.), Ethical dilemmas in biotechnology entrepreneurship, Compliance and risk management strategies.

References:

1. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies by Craig Shimasaki, Academic Press, 2014.
2. Biotechnology Entrepreneurship: Leading, Managing and Commercializing Innovative Technologies by Craig Shimasaki, Elsevier Science, 2020.
3. Innovation and Entrepreneurship in Biotechnology, an International Perspective: Concepts, Theories and Cases by Damian Hine and John Kapeleris, 2006.
4. Bioentrepreneurship and Transferring Technology Into Product Development by Sonu Kumari, Suphiya Khan and Swati Agarwal, IGI Global, 2021.
5. Selected articles from journals, and case studies.