UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A' GRADE' UNIVERSITY)
(Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(24/July/Adp./42)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the Syllabi and Courses of Studies of the subject of **Biotechnology** of Semester **Vth, VIth, VIIth and VIIIth** for **Four Year Under Graduate Programme (FYUGP)** as per **NEP-2020 (as given in the annexure)** for the examinations to be held in the years as per the details given below:

Subject	**Semester**	**For the examinations to be held in the year**
Biotechnology	Semester- V	Dec. 2024, 2025 and 2026
	Semester-VI	May 2025, 2026 and 2027
	Semester-VII	Dec. 2025, 2026 and 2027
	Semester- VIII	May 2026, 2027 and 2028

The Syllabi of the courses is also available on the University website: www.jammuuniversity.ac.in.

2/7/2024
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/24/ 6006-25
Dated: 3/7/24.

Copy for information and necessary action to:

1. Dean, Faculty of Life-Science
2. HOD/Convener, Board of Studies in **Biotechnology**
3. Sr. P.A.to the Controller of Examinations
4. All members of the Board of Studies
5. Confidential Assistant to the Controller of Examinations
6. I/C Director, Computer Centre, University of Jammu
7. Deputy Registrar/Asst. Registrar (Conf. /Exams. UG)
8. Incharge, University Website for Uploading of the notification

Sem- 5th	Major	UMJBTT-501	**Animal Biotechnology**	4 (3+1)
	Major	UMJBTT-502	**Genetic Engineering**	4 (3+1)
	Major	UMJBTT-503	**IPRs, Bioethics and Entrepreneurship in Biotechnology**	4 (3+1)
	Major	UMJBTT-504	**Medical Biotechnology**	2 (2+0)
	Minor	UMIBTT-505	**Introduction to Genetic Engineering**	4 (3+1)
	Skill Enhancement SEC	USEBTI-506	**Summer internship**	2
				20 credits
Sem- 6th	Major	UMJBTT-601	**Genomics and Proteomics**	4 (3+1)
	Major	UMJBTT-602	**Plant Biotechnology**	4 (3+1)
	Major	UMJBTT-603	**Bioprocess Engineering**	4 (3+1)
	Major	UMJBTT-604	**Applied and Advanced Microbiology**	4 (3+1)
	Minor	UMIBTT-605	**Introduction to Genomics and Proteomics**	4 (3+1)
				20 credits
Sem- 7th	Major	UMJBTT-701	**Nanobiotechnology**	4 (3+1)
	Major	UMJBTT-702	**Environmental Biotechnology**	4 (3+1)
	Major	UMJBTT-703	**Food Biotechnology**	4 (3+1)
	Major	UMJBTT-704	**Biostatistics and Bioinformatics**	4 (3+1)
	Minor	UMIBTT-705	**Introduction to Nanobiotechnology**	4 (3+1)
				20 credits
Sem- 8th Honours	Major	UMJBTT-801	**Industrial Biotechnology**	4 (3+1)
	Major	UMJBTT-802	**Structural Biology**	4 (3+1)
	Major	UMJBTT-803	**Advances in Biotechnology**	4 (3+1)
	Major	UMJBTT-804	**Vaccine and drug designing**	4 (3+1)
	Minor	UMIBTT-805	**Introduction to vaccine and drug designing**	4 (3+1)
				20 credits
			OR	
Sem- 8th Research	Major	UMJBTT-806	**Research Methodology**	4 (3+1)
	Minor	UMIBTT-807	**Introduction to Research Methodology**	4 (3+1)
	Skill Enhancement SEC	USEBTP-808	**Research project**	12
				20 credits

University of Jammu
Syllabi of Biotechnology for FYUGPunder CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

MAJOR COURSE
Course Code: UMJBTT-501
Course Title: Animal Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

The course is designed to give students a perspective on cutting edge biotechnologies that can be used for animal and human health and research. Course enable them to develop basic skills for cell culture, maintenance of cell lines, to understand the principles of animal cloning, tissue engineering, stem cell technology, animal reproductive biotechnology and their applications.

Unit I: Introduction to Animal Biotechnology
Introduction and brief history of animal tissue culture, lab requirements, equipment and maintenance of aseptic conditions, washing, sterilization of glassware and media preparation, primary and secondary cultures, cell lines

Unit II:Tools and Techniques
Basic tools for animal tissue culture – commonly used cell lines, Significance of animal tissue culture. Electroporation, transfection methods, Biology of viral vectors: SV40, adenovirus, retrovirus, vaccinia virus vectors and its applications.

Unit III:Transgenics
Genetic engineering as applied to production of regulatory proteins, blood, products, vaccines and hormones. transformation of animal cells,Gene knockout technology, Gene therapy, Transgenic in animal biotechnology research.

Unit IV:Stem cell technology
Introduction to Stem Cell Technology and its applications; Animal propagation, Artificial insemination, Animal Clones, Embryo transfer techniques, Conservation Biology

PRACTICALS

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

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Course Title: Animal Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

SUGGESTED READINGS

1. Freshney, R.I (2007) Culture of animal cells: A manual of Basic Technique. Jonh Wiley and Sons Inc., USA.
2. Gordon I. 2005. Reproductive Techniques in Farm animals. CABI.
3. Portner R. 2007. Animal Cell Biotechnology. Humana Press.
4. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
5. Barry R Bloom, Paul- Henri Lambert 2002. The Vaccine Book. Academic press.
6. Srivastava, A. K., Singh, R.K., Yadav, M.P. (2009). Animal Biotechnology, Oxford and IBH publishing company, New Delhi.
7. Sateesh, M.K.(2005). Biotechnology-5: Animal Cells, Immunology & Plant Biotechnology. New Age International (L),Pvt., New Delhi.
8. Masters, John R.W. (2000). Animal Cell Culture – Practical approach, Oxford, Univeristy Press, Oxford.

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
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MAJOR COURSE
Course Code: UMJBTT-501
Course Title: Animal Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours
B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

MAJOR COURSE
Course Code: UMJBTT-502
Course Title: Genetic Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME
This course is about the application of molecular biology and includes the techniques based on it. The student is introduced to basic tools and techniques used in genetic engineering along with the principles they are based on. The course includes nucleic acid extraction, gene cloning, PCR and DNA sequencing along with other topics relevant to genetic engineering.

Unit I: Principles and Tools in Genetic Engineering
Introduction to the principles and significance of genetic engineering; Exploration of essential tools used in genetic engineering, including restriction enzymes, nucleases, ligases, phosphatases, and kinases; Understanding the concept of vectors; Selection and characterization of appropriate vectors for cloning. Nucleic acid extraction, Principles and methods

Unit II: Cloning: techniques and types
Genomic and cDNA libraries; Construction of the genomic and cDNA library for specific for gene of interest, Screening the libraries: function based screening and sequence based screening. Isolation, identification and characterization of specific gene. Introduction to PCR, principle and working; design and importance of primer, PCR program and assay, Types of PCR, Role of PCR in gene cloning and diagnostics.

Unit III: DNA Sequencing
Introduction to three generation of DNA sequencing, Detailed account of Sangers and Maxam Gilbert method of sequencing, automated Sanger sequencing, Introduction to Next generation sequencing platforms.

Unit IV:Gene Editing and Genome Engineering
Overview of gene editing technologies, such as CRISPR-Cas9, TALENs, and ZFNs; Site-directed mutagenesis and gene knockout strategies; RNA interference (RNAi) and gene silencing techniques; Ethical considerations and challenges associated with gene editing technologies.

PRACTICALS
1. Culturing *E.coli* DH5 α in media for isolation of Plasmid DNA.
2. Isolation of plasmid DNA from bacterial cells.
3. Isolation of Genomic DNA from Bacterial Cells.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

MAJOR COURSE
Course Code: UMJBTT-502
Course Title: Genetic Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

4. Preparation of Agarose gel for electrophoresis.
5. Checking Bacterial genomic and Plasmid DNA on Agarose gels of different percentages and identifying the differences.
6. Restriction enzyme digestion and analysis of DNA fragments by gel electrophoresis.
7. Demonstrate the process of Ligation of DNA fragments and transformation into bacterial cells.
8. Demonstrate the process of Screening and selection of transformed cells.
9. Demonstrate Polymerase Chain Reaction (PCR) amplification of target DNA sequences.
10. Analysis of PCR products using gel electrophoresis.
11. Cloning and expression of a target gene in a host organism.
12. Analysis of gene expression using reporter assays.
13. Bioinformatics analysis of DNA and protein sequences using online tools.
14. Design and presentation of a genetic engineering project proposal.
15. Visit to National level institutes for practical knowledge.

SUGGESTED READINGS

1. Brown T.A. (2020) Gene Cloning and DNA analysis: An Introduction . Wiley-Blackwell Publishing, UK
2. Glick BR and Patten CL (2017) Molecular Biotechnology: Principles and Application of recombinant DNA. ASM Press, USA
3. Green M. R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual. CSHL Press, USA.
4. Primrose, S. B. and Twyman, R. M. (2006) Principles of Genetic Manipulation and Genomics. Blackwell Publishing, UK.
5. Voet, D., Voet, J. G. and Pratt C. W. (2018) Voet's Principles of Biochemistry. John Wiley & Sons, UK.
6. Andreas Hofmann and Samuel Clokie (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.

University of Jammu
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Semester – 5th(Examination to be held in December 2024, 2025, 2026)

MAJOR COURSE
Course Code: UMJBTT-502
Course Title: Genetic Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – V (Examination to be held in December 2023, 2024, 2025)

MAJOR COURSE
Course Code: UMJBTT-503
Course Title: IPRs, Bioethics and Entrepreneurship in Biotechnology
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hours

Objectives and Expected Learning Outcomes

This course will introduce the concept of Intellectual Property Rights, types, procedure, limit a. Further it will also address bioethical concerns arising from the commercialization of biological products, GM foods, stem cell research, organ transplantation etc. The course will also provide the concept of entrepreneurship, generating ideas, concept of startups and incubation centre

Unit I: Intellectual Property Rights in Biotechnology

Introduction to Intellectual Property Rights (IPRs): importance of Intellectual property rights, types of Intellectual Property rights, copyrights, trademarks, trade secrets, geographical indications, patent: composition of a patent, purpose of patents, patentable subject matter; *sui generis* system: plant variety protection

Unit II: Basic concepts of patenting

Searching and analysing patents, patent application, infringement of a patent, licensing of patents, technology transfer agreement, introduction to Indian and US patent office, salient features of Indian patent law and its amendments, introduction to TRIPS, WIPO etc.

Unit III: Bioethics

Definition and scope of bioethics: principles of bioethics; traditional knowledge and bioethics, ethical considerations in genetic engineering and cloning: organ transplantation, stem cells;informed consent and human subjects research.

Unit IV: Entrepreneurship Development

Introduction to social and business entrepreneurship: basic characteristics; developing entrepreneurship through training and motivation, leveraging resources and creating value, entrepreneurial opportunities in biotechnology, structure and different stages of companies (agri-based, pharma-based etc.), concept of startups and challenges, incubation centre

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – V (Examination to be held in December 2023, 2024, 2025)

MAJOR COURSE
Course Code: UMJBTT-503
Course Title: IPRs, Bioethics and Entrepreneurship in Biotechnology
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hours

PRACTICALS

1. Patent searching tool (e.g. Google Patents)
2. Demonstration and retrieval of patent data from Espacenet.
3. To study working of PatentScopeT
4. To study working of The Lens Org
5. File a mock patent application in Indian Patent office
6. File a mock patent application in USPTO.
7. To constitute an ethical committee and review cases related to Biotechnology
8. To draft a start-up project
9. Industrial Visit
10. A visit to an incubation/ acceleration centre

SUGGESTED READINGS

1. Intellectual Property Rights: Legal and Economic Challenges for Development by Mario Cimoli et al.
2. Intellectual property rights on Biotechnology by K. Singh BCII, New Delhi.
3. Ganguli P.; (2006) Intellectual Property Rights, Tata Mcgraw Hill Publishing Co Ltd.
4. Ahuja VK; (2015) Intellectual Property Rights in India Lexis, Nexis, and New Delhi.
5. Principles of Biomedical Ethics by Tom L. Beauchamp and James F. Childress
6. Ahmetoglu et al., (2017) The Wiley handbook of entrepreneurship, John Wiley and sons, UK.
7. Craig S; (2020) Biotechnology entrepreneurship, Academic Press (Elsevier), UK.
8. Padma N; (2017) An introduction to Ethical, Safety and intellectual property rights
9. Patzelt, H, Brenner T; (2008) Handbook of Bioentrepreneurship, Springer Publications.
10. Singh HB, Jha A and Keswani C; (2016) Intellectual property issues in Biotechnology, CABI, UK.
11. Hopkins T and Perui O (2019) The smart start up, Jaico publishing house, Mumbai
12. Venkatratnam JB (2009) Entrepreneurship Development, Heritage Printers, Hyderabad.
13. Zaware N; (2018) Entrepreneurship development and start up management
14. Castle D (2009) The Role of Intellectual Property Rights in Biotechnology
15. The Patent Act, 1970 (ipindia.gov.in)&WIPO (wipo.int)

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – V (Examination to be held in December 2023, 2024, 2025)

MAJOR COURSE
Course Code: UMJBTT-503
Course Title: IPRs, Bioethics and Entrepreneurship in Biotechnology
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hours

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

A) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).

b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.

c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5 (Examination to be held in December 2024, 2025, 2026)

MAJOR COURSE
Course Code: UMJBTT-504
Course Title: Medical Biotechnology
Credits: 2 (Theory)
Total No. of Lectures: Theory: 25 hours
Maximum Marks: 50
Theory: 50
Duration of Examination: 2.5 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

The objective of the course is to make students aware about the various medical diagnostic techniques and their use in diagnosing various disorders in humans. The course would enables the student to understand basic principal of the diagnostic techniques and its application in medical biotechnology.

Unit I: Disease Biology and Immunodiagnostics
DiseaseBiology: Characteristics and features of diseases, classification of disease, Pathogens and its types virulence factors, course of infection; Infectious diseases (HIV, Cancer, Covid-19).
Immunodiagnostics: Enzyme-Linked Immunosorbent Assays (ELISA) and its role in diagnosing disease-associated proteins biomarkers, Autoimmune Diseases, Immunoassays for Infectious Disease

Unit II: Nucleic acids based diagnostic approaches:
Hybridisation Probes, Allele-specific PCR, TaqMan PCR, Real-Time PCR, Detection of Epigenetic Markers, Detection of Multiple Disease-Associated Mutations Using Microarrays, Forensic and DNA Profiling

Unit III: Therapeutics
Protein Therapeutics: Interferon, Human Growth Hormone, Recombinant Antibodies, monoclonal antibodies, Anticancer Antibodies.
Gene Therapy- Ex vivo versus in vivo gene therapy, Gene Delivery Methods: Viral and non-viral delivery methods.
Tissue Engineering- Xenotransplantation, Drug Delivery: Basic concepts and Market perspective, Vaccines and types, pre-natal and pre-implantation diagnosis

SUGGESTED READINGS

1. Medical Biotechnology by Bernard R Glick, Terry L. Delovitch, Cheryl L. Patten (2014) ASM press, doi:10.1128/9781555818890
2. Medical Biotechnology by Pratibha Nallari & V. Venugopal Rao (2010). Oxford University Press, India, **ISBN:** 9780195699609
3. Medical Biotechnology by S Jogdand (2017) Himalaya Publishing House. **ISBN Number :** 978-93-5024-701-3
4. Biotechnology: An Introduction - by Susan R. Barum 2nd ed (2005) Thomson/Brooks/Cole, 2005, ISBN 0495112054, 9780495112051

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5 (Examination to be held in December 2024, 2025, 2026)

MAJOR COURSE
Course Code: UMJBTT-504
Course Title: Medical Biotechnology
Credits: 2 (Theory)
Total No. of Lectures: Theory: 25 hours
Maximum Marks: 50
Theory: 50
Duration of Examination: 2.5 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	10
External Theory End Semester	100%	3 Hours	40

A) **Mid Term Assessment test: (10 Marks) Time Allotted 1 Hours**

B) **External End Semester Examination: (40 Marks) Time Allotted 2 ½ Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 10 marks and comprise of 4 short answer type questions of 2½ marks each, from Unit I, II and III (All compulsory).
   c) Section B shall be of 30 marks and will comprise of four long type questions of 10 marks each, two from Unit I, two from Unit II, two from Unit III. A candidate has to attempt one from each unit..

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

MINOR COURSE
Course Code:UMIBTT-505
Course Title: Introduction to Genetic Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

This course is about the application of molecular biology and includes the techniques based on it. The student is introduced to basic tools and techniques used in genetic engineering along with the principles they are based on. The course includes nucleic acid extraction, gene cloning, PCR and DNA sequencing along with other topics relevant to genetic engineering .

Unit I: Principles and Tools in Genetic Engineering

Introduction to the principles and significance of genetic engineering; Exploration of essential tools used in genetic engineering, including restriction enzymes, nucleases, ligases, phosphatases, and kinases; Understanding the concept of vectors,; Selection and characterization of appropriate vectors for cloning. Nucleic acid extraction, Principles and methods

Unit II: Cloning: techniques and types

Genomic and cDNA libraries; Construction of the genomic and cDNA library for specific for gene of interest, Screening the libraries: function based screening and sequence based screening. Isolation, identification and characterization of specific gene. Introduction to PCR, principle and working; design and importance of primer, PCR program and assay, Types of PCR, Role of PCR in gene cloning and diagnostics.

Unit III: DNA Sequencing

Introduction to three generation of DNA sequencing, Detailed account of Sangers and Maxam Gilbert method of sequencing, automated Sanger sequencing, Introduction to Next generation sequencing platforms.

Unit IV:Gene Editing and Genome Engineering

Overview of gene editing technologies, such as CRISPR-Cas9, TALENs, and ZFNs; Site-directed mutagenesis and gene knockout strategies; RNA interference (RNAi) and gene silencing techniques; Ethical considerations and challenges associated with gene editing technologies.

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University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

MINOR COURSE
Course Code:UMIBTT-505
Course Title: Introduction to Genetic Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS:

1. Culturing *E.coli* DH5 α in media for isolation of Plasmid DNA.
2. Isolation of plasmid DNA from bacterial cells.
3. Isolation of Genomic DNA from Bacterial Cells.
4. Preparation of Agarose gel for electrophoresis.
5. Checking Bacterial genomic and Plasmid DNA on Agarose gels of different percentages and identifying the differences.
6. Restriction enzyme digestion and analysis of DNA fragments by gel electrophoresis.
7. Demonstrate the process of Ligation of DNA fragments and transformation into bacterial cells.
8. Demonstrate the process of Screening and selection of transformed cells.
9. Demonstrate Polymerase Chain Reaction (PCR) amplification of target DNA sequences.
10. Analysis of PCR products using gel electrophoresis.
11. Cloning and expression of a target gene in a host organism.
12. Analysis of gene expression using reporter assays.
13. Bioinformatics analysis of DNA and protein sequences using online tools.
14. Design and presentation of a genetic engineering project proposal.
15. Visit to National level institutes for practical knowledge.

SUGGESTED READINGS

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Green M. R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual. CSHL Press, USA.

Primrose, S. B. and Twyman, R. M. (2006) Principles of Genetic Manipulation and Genomics. Blackwell Publishing, UK.

Voet, D., Voet, J. G. and Pratt C. W. (2018) Voet's Principles of Biochemistry. John Wiley & Sons, UK.

Andreas Hofmann and Samuel Clokie (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

MINOR COURSE
Course Code:UMIBTT-505
Course Title: Introduction to Genetic Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**

B) **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

SKILL ENHANCEMENT COURSE
Course Code: USEBTI-506
Course Title: Summer internship
Credits: 2
Maximum marks: 50

OBJECTIVES AND EXPECTED LEARNING OUTCOME

It shall be a short-term internship of 15 days duration in 5th semester for job/professional training in a suitable organization or hands on training or activity-based course at college level in order to gain work experience. All students will undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the summer term. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Community engagement and service: The curricular component of "community engagement and service" seeks to expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity.

Field-based learning/minor project: The filed-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This may be a summer term project.

Skill based training: Short term skill-based hands-on training can be conducted on various techniques utilized in biotechnology course. Students can undergo internships in labs with faculty and researchers in their own or other HEIs/research institutions during the summer term. These trainings will enhance the skill of student that can be applicable for getting skill based jobs.

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 5th (Examination to be held in December 2024, 2025, 2026)

SKILL ENHANCEMENT COURSE
Course Code: USEBTI-506
Course Title: Summer internship
Credits: 2
Maximum marks: 50

SCHEME OF EXAMINATION

The internship shall be under a college teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out signed by internship supervisor and college principal. The internship will be evaluated internally by a Board of Examiners set up by the principal of the college.

Note: The minimum passing criteria for the summer internship is 40%.

Report Guidelines: The interns will write their report as per the format given below:

1. Introduction
2. Materials and Methods
3. Results
4. Discussion
5. Conclusion
6. References

This structure allows participants to gain hands-on experience in various laboratory techniques and apply their knowledge through a project. The project report serves as a valuable component to assess their understanding and application of the learned skills.

Monitoring and Evaluation: The designated Internship Supervisor will monitor the progress and evaluate student' s internship course at the end of semester on the basis of

Internship Report/Seminar presentation/Viva-voce. The evaluation of the internship course shall be internal.

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UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN BIOTECHNOLOGY
BIOTECHNOLOGY COURSE
SEMESTER VI

Semester	Types of Courses	Course code	Title	Credits
Sem- 6th	Major	UMJBTT-601	**Genomics and Proteomics**	4 (3+1)
	Major	UMJBTT-602	**Plant Biotechnology**	4 (3+1)
	Major	UMJBTT-603	**Bioprocess Engineering**	4 (3+1)
	Major	UMJBTT-604	**Applied and Advanced Microbiology**	4 (3+1)
	Minor	UMIBTT-605	**Introduction to Genomics and Proteomics**	4 (3+1)
				20 credits

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6 (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-601
Course Title: Genomics and Proteomics
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

The course provides an introduction to Genomics and Proteomics. After successful completion of course, the students will be able to understand genome organization, gene identification and gene expression. Students will be acquainted with proteomics and its applications.

Unit I: Genomics

Introduction and structure of genomes, Genome size, C-Values of genomes. Sequence complexity, Introns and Exons, Genome structure in prokaryotes and eukaryotes.Mutations, Gene variation, Genome analysis usingMolecular markers - RFLP, RAPD, AFLP, microsatellites and SNPs.

Unit II: Gene Identification and Expression

Organization of eukaryotic genome within the nucleus, chloroplast and mitochondria, Regulation of transcription, transcription factors and the co-ordination of gene expression. Genome annotation, traditional routes of gene identification, detecting open-reading Frames, Overview of comparative genomics.

Unit III: Proteomics

Introduction to Proteomics- Two-dimensional polyacrylamide gel electrophoresis, Mass spectrometry based methods for protein identification: principle, procedure and application, Detection of proteins on SDS gels, Protein cleavage, An overview of Micro array techniques and applications.

Unit IV: Applications of Genomics and Proteomics

Analysis of Genomes, Functional genomic studies with model systems such as Drosophila, Yeast or *C. elegans.* Human genome project and the genetic map. Application of proteome analysis-Proteomics in medicine and crop improvement.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6 (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-601
Course Title: Genomics and Proteomics
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS:

1. Isolation of genomic DNA
2. Preparation of agarose gel
3. Setting up of a PCR reaction
4. DNA fingerprinting using gel electrophoresis
5. Precipitation of proteins with heavy metals
6. Demonstration of two-dimensional gel electrophoresis
7. Use of bioinformatics tools to analyse proteomics data
8. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READINGS

1. Introduction to Genomics Arthur M Lesk Oxford University Press 2007
2. Fundamentals of Genomics. Victor Kennedy, Larsen and Keller Education, 2018
3. From Proteins to Proteomics: Basic Concepts, Techniques, and Applications. Sanjeeva Srivastava, CRC Press; 1st edition, 2022
4. Plant Genomics: Methods and Protocols, Humana Press, 2018
5. Genomics and Proteomics Principles, Technologies, and Applications. Devarajan Thangadurai, Jeyabalan Sangeetha, CRC Press, 2021.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6 (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-601
Course Title: Genomics and Proteomics
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs
NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A. **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**
B. **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
   c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code:UMJBTT-602
Course Title: Plant Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

The course provides an introduction to Plant Biotechnology. After successful completion of course, the students will be able to acquainted with plant culture techniques and culture types, transgenic plants with herbicide, pest and disease resistance, abiotic stress resistance along with nutritional enhancement traits for improved quality. Students will also understand the the role of plants as food, feed and medicine and the biosynthesis of various plant compounds.

Unit I: Introduction to plant tissue culture

Introduction and brief history of plant tissue culture; Laboratory requirements and general techniques. Sterilization (Physical and chemical methods), Culture medium and its type, Growth regulators: Auxins, cytokinins, Gibberellins, abscisic acid, ethylenetype of gelling agents. Concept of Totipotency of cells, differentiation, dedifferentiation and redifferentiation

Unit II: Types of cell culture

Micropropagation and its applications, Cell culture: Isolation of single cells, suspension culture. Types of culture: Embryo, Organ, Callus culture Haploid culture: Anther, pollen and ovule culture, Embryo rescue Meristem tip culture and production of virus free plants, by heat and chemical treatment; Somaclonal and Gametogonal variation and their significance.

Unit III: Protoplast culture and germplasm conservation

Isolation of protoplast (Physical and chemical methods), regeneration and their viability, Methods of protoplast fusion – chemical and electro fusion, Cybrids, Application of somatic hybridization and cybridization. Gene banks, Germplasm storage: Long term and short term storage.

Unit IV: Plant transgenics and their applications

Genetic engineering of plant – gene transfer methods, *Agrobacterium* mediated and vectorless transformation: PEG mediated DNA uptake, gene-gun or Biolistic method, Ti and Ri plasmid, Vectors used in plant transformation, promoters, terminators, scorable and selectable markers: Use of transgenic plants: BT Cotton, Golden rice.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-602
Course Title: Plant Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS:

1. Safety measures in laboratory and acquaintance to lab Instruments/equipments
2. General demonstration of a tissue culture lab
3. Preparation of medium
4. Selection of explant and methods of sterilization
5. Demonstrate the process of micropropagation
6. Callus induction and regeneration
7. Rooting and Shooting of callus using Auxins and Cytokinins
8. Hardening of the tissue culture generated plantlets
9. Formation of cell suspension and cell culture
10. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READINGS

1. Plant Tissue Culture: Application and Limitation by S. S. Bhojwani and M. K.Razdan, Elsevier Publication, 2019 3rd edition
2. Plants, Genes and Agriculture by Maarten J Chrispeels and David E. Sadava, Jones & Bartlett Publishers, 1994
3. An Introduction to Plant Tissue Culture by M. K. Razdan, Oxford & IBH Publishing Co. Pvt. Ltd., 2019
4. Plant Biotechnology: The genetic manipulation of plants by Adrian Slater, NigelScott, and MarkFowler, Oxford University Press., 2008
5. Plant Biotehnology. B.D Singh, Kalyani Publishers, 2015

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-602
Course Title: Plant Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

A) **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**

B) **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

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Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code:UMJBTT-603
Course Title: Bioprocess Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME:
This course is to introduce students to Understand the fundamental principles of bioprocess engineering, its historical development, and the engineering aspects of microbial processes and help them to develop understanding of design, operation and optimization of bioprocess systems for production of products of industrial significance such as pharmaceuticals, food, biofuels, and more. Students will learn the techniques for monitoring and controlling bioprocesses, including instrumentation, automation and techniques for the separation, purification, and recovery of bioproducts from fermentation broths. They will also learn how to scale up laboratory-scale bioprocesses to industrial production levels.

Unit - I: Introduction to Bioprocess Engineering
Introduction to bioprocess engineering and technology, Concept of fermentation vs bioprocess; Concept of microbial growth and death; Microbial growth phases (lag, log, stationary, death); Growth rate equations; factors affecting microbial growth; Types of fermentation/bioprocesses: Batch, Fed-batch and continuous bioprocesses.

Unit -II: Media and Sterilization
Media for Isolation: Base Media, Carbon Sources, Nitrogen Sources, Mineral Salts, Vitamins; Preservation and Maintenance of Industrial microorganisms; Sterilization Techniques of air and media: Autoclave, Filtration, Chemical Sterilization, Radiation, Dry Heat, UV Sterilization, and In-Place Sterilization; Concept of scale up; Practical aspects and issues of process scale up for sterilization.

Unit -III: Bioreactors And Bioprocess Based Products
Bioreactors: stirred tank reactor, non-agitated bioreactors, packed bed, fluidized bed; Introduction to the use of Microorganisms in the production of Alcohol (ethanol); bioethanol-Biofuel from sugary and non-sugary (starches, lignocelluloses) sources; Organic Acid (citric acid); Solvents (glycerol); Industrial enzymes (amylases); Antibiotics (penicillin); Amino-acids (lysine), Single Cell Protein, Probiotics, and prebiotics.

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Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code:UMJBTT-603
Course Title: Bioprocess Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit -IV: Bioprocess Monitoring and Downstream Processing
Monitoring and control of process parameters (pH, temperature, dissolved oxygen, etc.); sensors; Role of computers in process monitoring, and control; Scale-up and scale-down considerations Biomass immobilization, approaches, merits, limitations, and Industrial Applications; Downstream processing (DSP), Criteria, steps involved in typical DSP operation; Removal of microbial cells and solid matter: foam separation, precipitation, filtration, centrifugation; Effluent treatment: B.O.D and C.O.D, treatment and disposal of effluents.

PRACTICALS
1. To isolate the yeast from different food sources.
2. To isolate citric acid producing fungus (*Aspergillus niger*).
3. To isolate ethanol producing yeast.
4. To demonstrate sterilization techniques used for media sterilization.
5. To determine the growth assay of industrially important organisms.
6. To determine the effect of pH on the growth of bacteria.
7. To determine the effect of temperature on the growth of bacteria.
8. To evaluate the thermal death time of bacteria.
9. Analysis of amylase activity by plate assay.
10. Analysis of cellulase activity by plate assay.
11. Immobilization of *Aspergillus niger* biomass for Citric acid production.
12. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READING
Stanbury, P.F. and Whitaker, A., (2016). Principles of Fermentation Technology. 3rd Edition. Pergamon Press, Oxford.
Shuler, M. L., and Kargi, F. (2020). Bioprocess Engineering: Basic Concepts. 3rd edition. Pearson.
Lee, S. Y., Nielsen, J., and Stephanopoulos, G. (2017). Industrial biotechnology: Products and processes. 1st edition. John Wiley & Sons.

Cruger, W. and Cruger, A. (2005). A Textbook of Industrial Microbiology. 2nd edition. Panima Publishing Corporation.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-603
Course Title: Bioprocess Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Bailey, J. E., and Ollis, D. F. (2021). Biochemical Engineering Fundamentals. 3rd edition. McGraw-Hill Education.

Blanch, H. W., and Clark, D. S. (2019). Biochemical Engineering (2nd edition). CRC Press.

Doran, P. M. (2019). Bioprocess Engineering Principles. 3rd edition. Academic Press.

Lee, S. Y., and Papoutsakis, E. T. (2021). Advances in Metabolic Engineering. 2nd edition. Springer.

Gavach, C., and Hittinger, C. T. (Eds.). (2020). Bioprocess Engineering for a Green Environment. CRC Press.

Aiba, S., Humphrey, A. E., and Millis, N. F. (2020). Biochemical Engineering. 1st edition. World Scientific Publishing.

Flickinger, M. C., and Drew, S. W. (Eds.). (2019). Encyclopedia of Bioprocess Technology: Fermentation, Biocatalysis, and Bioseparation. 2nd edition. Wiley.

Nielsen, J., and Villadsen, J. (2021). Bioreaction Engineering Principles. 4th edition. Springer.

Subramanian, G., and Nedunchezhian, N. (2020). Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design. 1st edition. CRC Press.

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-603
Course Title: Bioprocess Engineering
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

A) **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**

B) **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

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Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-604
Course Title: Applied and Advanced Microbiology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

After completion of the course, students will be able to summarize and explain the roles of microbes in industrial and food processes. Students can relate their knowledge of traditional microbiological techniques to the utilization and control of microorganisms and can calculate and evaluate microbial growth and death rates. Students will be able to assess the use of microbes as tools in biotechnology and valuate cutting-edge technologies such as CRISPR-Cas gene editing, microbiome research, and synthetic biology, including their applications, implications, and ethical considerations.

Unit I: Microbial Growth and Death Rates

Microbial Growth Kinetics: - Factors influencing microbial growth, Calculation and interpretation of growth rate, Applications of growth kinetics in industrial settings
Microbial Death Rate: - Factors affecting microbial death rate, Calculation and evaluation of death rate, Techniques for microbial control and sterilization

Unit II: Microbes in Industrial and Food Processes

Roles of Microbes in Industrial Processes: - Overview of microbial involvement in various industrial sectors, traditional microbiological techniques & control strategies for microbial contamination in industrial processes, regulatory aspects and quality control, microbial applications in manufacturing and production, Case studies of successful industrial microbial processes. Roles of Microbes in Food Processes: - Microbial involvement in food fermentation and preservation, Foodborne pathogens and spoilage microorganisms, Applications of microbial enzymes in food processing.

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-604
Course Title: Applied and Advanced Microbiology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit III: Microbes as Tools in Biotechnology

Applications of Microbes in Bioprocessing: - Microbial production of biofuels, chemicals, and pharmaceuticals, Bioprocess optimization and scale-up considerations, Economic and environmental aspects of microbial bioprocessing

Microbes in Genetic Engineering: - Principles of genetic engineering in microbial systems, Recombinant DNA technology and its applications, Ethical considerations in genetic engineering

Unit IV: Frontiers in Microbiology

CRISPR-Cas Technology: - Principles of CRISPR-Cas gene editing, Applications in microbiology, medicine, and agriculture, Ethical considerations and challenges in CRISPR-Cas technology

Microbiome Research: - Significance of the human microbiome, Microbiome studies in health and disease, Therapeutic implications of microbiome research

Synthetic Biology: - Fundamentals of synthetic biology, Design and construction of synthetic microbial systems, Applications in medicine, industry, and environmental management, Ethical and regulatory aspects of synthetic biology

PRACTICALS:

1. To Isolate and identify microbes from various sources.
2. Set up a simple fermentation experiment using basic bioreactors to observe the growth of microbes and production of metabolites.
3. Assess the presence of foodborne pathogens in food samples using basic microbiological techniques.
4. Implement traditional microbiological techniques for microbial control in an industrial setting.

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Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-604
Course Title: Applied and Advanced Microbiology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

5. Use a spectrophotometer to measure the optical density of a microbial culture over time and construct a microbial growth curve
6. To perform disk diffusion assays to test the sensitivity of microbes to different antimicrobial agents.
7. To measure the activity of microbial enzymes using colorimetric or spectrophotometric assays
8. Extract DNA from a microbial community sample and use PCR to amplify and analyze specific microbial genes.
9. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READINGS

1. "Industrial Microbiology: An Introduction" by Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton (2011), Wiley-Blackwell
2. "Food Microbiology: Fundamentals and Frontiers" by Michael Doyle, Robert Buchanan (2012), ASM Press
3. "Microbial Growth in Biofilms - Part A: Developmental and Molecular Biological Aspects" by David C. Montie, Matthew R. Parsek, Elizabeth J. Griebe (2001), Academic Press
4. "Genetics: From Genes to Genomes" by Leland H. Hartwell, Michael L. Goldberg, Janice Fischer, Leroy Hood (2017), McGraw-Hill Education
5. "Essentials of Genetics" by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino (2018), Pearson
6. "Bioprocess Engineering: Basic Concepts" by Michael L. Shuler, Fikret Kargi (2001), Prentice Hall
7. "CRISPR-Cas: A Laboratory Manual" by Jennifer Doudna, Prashant Mali (2016), Cold Spring Harbor Laboratory Press
8. "The Human Microbiota and Microbiome" by Richard L. Gallo, Matthew H. Schwede (2018), ASM Press

MAJOR COURSE
Course Code: UMJBTT-604
Course Title: Applied and Advanced Microbiology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

9. Synthetic Biology: A Lab Manual" by José P. M. S. de Souza, Danilo M. L. Freire (2014), Springer
10. "Microbial Biotechnology: Fundamentals of Applied Microbiology" by Alexander N. Glazer, Hiroshi Nikaido (2007), Cambridge University Press

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A. Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours
B. External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MINOR COURSE
Course Code: UMIBTT-605
Course Title: Introduction to Genomics and Proteomics
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME
The course provides an introduction to Genomics and Proteomics. After successful completion of course, the students will be able to understand genome organization, gene identification and gene expression. Students will be acquainted with proteomics and its applications.

Unit I: Genomics
Introduction and structure of genomes, Genome size, C-Values of genomes. Sequence complexity, Introns and Exons, Genome structure in prokaryotes and eukaryotes, Mutations, Gene variation, Genome analysis usingMolecular markers - RFLP, RAPD, AFLP, microsatellites and SNPs.

Unit II: Gene Identification and Expression
Organization of eukaryotic genome within the nucleus, chloroplast and mitochondria, Regulation of transcription, transcription factors and the co-ordination of gene expression. Genome annotation, traditional routes of gene identification, detecting open-reading Frames, Overview of comparative genomics.

Unit III: Proteomics
Introduction to Proteomics- Two-dimensional polyacrylamide gel electrophoresis, Mass spectrometry based methods for protein identification: principle, procedure and application, Detection of proteins on SDS gels, Protein cleavage, An overview of Micro array techniques and applications.

Unit IV: Applications of Genomics and Proteomics
Analysis of Genomes, Functional genomic studies with model systems such as Drosophila, Yeast or *C. elegans.* Human genome project and the genetic map. Application of proteome analysis-Proteomics in medicine and crop improvement.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MINOR COURSE
Course Code: UMIBTT-605
Course Title: Introduction to Genomics and Proteomics
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS

1. Isolation of genomic DNA
2. Preparation of agarose gel
3. Setting up of a PCR reaction
4. DNA fingerprinting using gel electrophoresis
5. Precipitation of proteins with heavy metals
6. Demonstration of two-dimensional gel electrophoresis
7. Use of bioinformatics tools to analyze proteomics data
8. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READINGS

1. Introduction to Genomics Arthur M Lesk Oxford University Press 2007
2. Fundamentals of Genomics. Victor Kennedy, Larsen and Keller Education, 2018
3. From Proteins to Proteomics: Basic Concepts, Techniques, and Applications. Sanjeeva Srivastava, CRC Press; 1st edition, 2022
4. Plant Genomics: Methods and Protocols, Humana Press, 2018
5. Genomics and Proteomics Principles, Technologies, and Applications. Devarajan Thangadurai, Jeyabalan Sangeetha, CRC Press, 2021.

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)

External Practical	-	-	**15**

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 6th (Examination to be held in May 2025, 2026 and 2027)

MINOR COURSE
Course Code: UMIBTT-605
Course Title: Introduction to Genomics and Proteomics
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours
B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN BIOTECHNOLOGY
BIOTECHNOLOGY COURSE
SEMESTER VII

Semester	Types of Courses	Course code	Title	Credits
Sem- 7th	Major	UMJBTT-701	**Nanobiotechnology**	4 (3+1)
	Major	UMJBTT-702	**Environmental Biotechnology**	4 (3+1)
	Major	UMJBTT-703	**Food Biotechnology**	4 (3+1)
	Major	UMJBTT-704	**Biostatistics and Bioinformatics**	4 (3+1)
	Minor	UMIBTT-705	**Introduction to Nanobiotechnology**	4 (3+1)
				20 credits

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7 (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-701
Course Title: Nanobiotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

To understand the nature and properties of nanomaterials. To provide scientific understanding of application of nanomaterials and nanotechnology in agriculture, health and environmental conservation.

Unit I:Introduction to nanomaterials: Development of nanobiotechnology - timelines and progress, overview. Various types of nanomaterials, Three-dimensional, two dimensional, one-dimensional and zero-dimensional nanomaterials , Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires

Unit II:Properties of nanomaterials: Synthesis of nanoparticles, Structural properties, chemical properties, surface functionalization, physical properties. Characterization of nanomaterials by various analytical methods, optical characterization and spectroscopy

Unit III:Nanobiotechnology in healthcare: Role of nanobiotechnology in the area of infectious & noninfectious diseases, Nanopharmaceuticals, Diagnosis, and biosensors, Delivery vehicles, biomedical applications of nanomaterials, targeted drug delivery

Unit IV:Nanobiotechnology for Agriculture: Nanotechnology based tools to enhance agricultural productivity, Nanobased Agri and Food Products, food preservation and toxicity, Nanopesticides and Nanofertilizers, Nanobiotechnology for Crop improvement, Nanotechnology for environment.

PRACTICALS

1. Synthesis of Ag nanoparticles using sodium borohydride (Creighton's method).
2. Synthesis of Au nanoparticles using citric acid (Lee –Meisel method)
3. Characterization of nanoparticles using UV spectrophotometry
4. Green synthesis of metal nanoparticles
5. Chemical synthesis of metal nanoparticles

MAJOR COURSE
Course Code: UMJBTT-701
Course Title: Nanobiotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

6. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READINGS

1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), Christof M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.
4. 4. E. Gazit, Plenty of room for biology at the bottom: an introduction to bionanotechnology (Imperial College Press ; Distributed by World Scientific Pub. in the USA, London : Hackensack, NJ, 2007).
5. 5. G. E. J. Poinern, A laboratory course in nanoscience and nanotechnology (CRC Press, Taylor & Francis Group, Boca Raton, 2015).
6. 6.C. A. Mirkin, C. M. Niemeyer, Eds., More concepts and applications (Wiley-VCH, Weinheim, 2007), Nanobiotechnology.
7. J. Kim, Ed., Advances in nanotechnology and the environment (Pan Stanford, Singapore, 2012).

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7 (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-701
Course Title: Nanobiotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-702
Course Title: Environmental Biotechnology
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

Upon completion of the course:

Student will be able to understand core principles, historical context, and societal relevance of environmental biotechnology.Student will be able to analyse human activities' effects on biogeochemical cycles and propose mitigation strategies. Student will be able to demonstrate effective waste treatment strategies and appropriate bioremediation techniques for air and soil pollution.Student will be able to understand emerging technologies like green energy, nanotechnology, GMOs, and biosensors in environmental contexts.

Unit I: Fundamentals of Environmental Biotechnology

Introduction to Environmental Biotechnology – Definition, scope, historical developments and Milestones; Relevance and Importance in Society. Global environmental issues: Pollution and its types – Air, water, soil, plastic and e-waste; Biotechnological interventions in pollution control. Biogeochemical Cycles and Environmental Processes - Carbon, Nitrogen, Phosphorus Cycles, Sulfur and Iron Cycles, Impacts of Human Activities on Biogeochemical Cycles.

Unit II: Waste Treatment and Remediation

Biological Treatment of Wastewater - Activated Sludge Process, Trickling Filters and Rotating Biological Contactors, Anaerobic Digestion and Methane Production. Physicochemical Treatment of Wastewater - Coagulation-Flocculation and Precipitation, Filtration and Membrane Processes. Solid Waste Management and Treatment - Source Separation and Collection Systems, Composting and Anaerobic Digestion.

Unit III: Air and Soil Bioremediation

Air Pollution and Control - Major Air Pollutants (SOx, NOx, VOCs, Particulates), Air Quality Standards and Regulations. Biofiltration and Bio-scrubbing Techniques, Bioconversion of Greenhouse Gases. Soil Contamination and Remediation Techniques - Types of Soil Contaminants (Heavy Metals, Organic Pollutants), Physical, Chemical, and Biological Remediation Approaches. Phytoremediation and Mycoremediation - Strategies and Applications.Bioremediation Techniques - In-situ vs Ex-situ Remediation, Enhanced Bioremediation, Strategies (Bioaugmentation, Biostimulation).

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-702
Course Title: Environmental Biotechnology
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit IV: Emerging Trends and Future Prospects

Green Energy from Biotechnology - Biogas Production, Microbial Fuel Cells , Algal Biofuels. Nanotechnology in Environmental Applications, Genetically Modified Organisms in Environmental Biotechnology - GMOs for Bioremediation and Pollution Control, Biocontainment and Environmental Safety Measures. Biosensors for Environmental Monitoring - Types of Biosensors, Bioplastics and their Applications.

PRACTICALS:

1. To measure the pH of various environmental samples. (e.g., soil, water).
2. To isolate and identify microorganisms from environmental samples.
3. To observe and analyze the growth of microorganisms over time.
4. Determination of Biological Oxygen Demand (BOD)
5. To observe and document the composting process.
6. To assess the biodegradability of specific environmental pollutants.
7. To demonstrate the phytoremediation potential of certain plants.
8. To measure the activity of an enzyme involved in environmental processes.
9. To visit the research institute/ University to get acquainted with advanced technique in related subject

SUGGESTED READING

1. "Environmental Biotechnology: Principles and Applications" by Bruce Rittmann and Perry McCarty (2019), McGraw-Hill Education.
2. "Biotechnology for Environmental Management and Resource Recovery" by Ramesh Chander Kuhad and Ajay Singh (2019), Springer.
3. "Principles of Environmental Biotechnology" by T. Pazirandeh and D. G. Fung (2008), Elsevier.
4. "Bioremediation: Principles and Applications" by Ronald L. Crawford and Don L. Crawford (2017), Cambridge University Press.
5. "Microbiology of Extreme Soils" by Antonio Ventosa and Yoav Bashan (2018), Springer.

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University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-702
Course Title: Environmental Biotechnology
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A. **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**
B. **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
   c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-703
Course Title: Food Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME:
This course is designed to provide students with a comprehensive understanding of the principles and applications of biotechnology in the food industry. This course will help them to gain knowledge of the microorganisms, food production by them, preservation, and spoilage. They will understand, how to control and manipulate microbial populations for food safety and quality, learn about fermentation processes used in the production and preservation of various food products, such as bread, yogurt, cheese and others. They will learn about food safety regulations, quality control, and quality assurance in the food industry. They will develop skills in detecting and managing food allergens and contaminants through biotechnological methods and the principles and techniques of genetic modification.

Unit I- Introduction to food science and technology
Definition and scope of food science and technology; historical development of food technology; Food characteristics: basics of chemistry of food constituents, composition, its classification; Minor constituents affecting texture, color, taste,odor; food additives; food preservatives; flavour enhancers; food allergy and intolerance; Microorganisms in food; Foodborne pathogens and spoilage microorganisms.

Unit II- Food processing, preservation and packaging
Principles of thermal processing; Calculation of process time temperature-schedules: Canning, Fermentation, Pasteurization and Sterilization; Food processing unit operations: drying, evaporation, membrane filtration; Introduction to food preservation by dehydration; thermal treatments and non- thermal processes hurdle technology and minimal processing technologies; Food packaging and its functions.

Unit III- Food safety and toxicology
Introduction to food additives and contaminants, Food hazards: Toxicity due to pesticides and herbicides Introduction to Food Safety; Salient features of Food Safety & Standards Act, 2006, Standards of identity, purity, and methodology for analysis of Canned foods. Risk assessment.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-703
Course Title: Food Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit IV- Food microbiology and genetically modified (GM) foods
Foodborne illness and epidemiology (including botulinum and staphylococcal toxins, mycotoxin ; Microbes in the food processing of various foods including dairy, bakery, brewing, pro and prebiotics and nutraceuticals; Detoxication strategy with concept, determination & importance of TDT, F, Z & D values; GM crops and biotechnology; Detection and labeling of GM foods; Safety assessment of GM foods; Role of WHO to improve evaluation of GM food, Benefits & Controversies.

PRACTICALS:
1. To prepare different types of media for bacterial growth.
2. To examine the change in colour of the food during spoilage.
3. To prepare the data of different additives and preservatives used in different food items with its properties.
4. To explore the preservation time of preservatives in some packed products.
5. To demonstrate the principles of canning as a food preservation method.
6. To quantify the number of viable Lactic Acid Bacteria (LAB) in a fermented food product.
7. To assess the microbial load in food samples.
8. To detect and identify foodborne pathogens (e.g., Salmonella, E. coli) in food samples.
9. To evaluate the effect of time of pasteurization for milk.
10. To evaluate the microbial reduction after pasteurization.
11. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READING

1. Smith, J. E., & Circle, S. J. (Eds.). (2018). Food Biotechnology (2nd ed.). CRC Press.
2. Fung, D. Y. C., & Deman, J. M. (2016). Food Safety in the 21st Century: Public Health Perspective. Academic Press.
3. Hui, Y. H., Evranuz, E. Ö., & Clary, C. (Eds.). (2017). Handbook of Plant-Based Fermented Food and Beverage Technology. CRC Press.
4. Varela, M. F., & Santos, J. E. (Eds.). (2020). Food Biotechnology: Advances in Biochemical Engineering/Biotechnology. Springer.
5. Khachatourians, G. G. (2017). Agricultural Biotechnology. CRC Press.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-703
Course Title: Food Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

6. Bevilacqua, A., Corbo, M. R., & Sinigaglia, M. (2018). Biotechnology in Functional Foods and Nutraceuticals. CRC Press.
7. Pandey, A., Negi, S., & Soccol, C. R. (Eds.). (2015). Advances in Fermentation Technology. Asiatech Publishers.

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A. **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**
B. **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
   c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-704
Course Title: Biostatistics and Bioinformatics
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hours

Objectives and Expected Learning Outcomes
High-throughput technologies produce massive amounts of data in form of sequences. The goal of this course is to learn how to analyse DNA, RNA, and protein sequences using computers. This course aims to demystify computer science and molecular biology and study their intersection. The course also sensitizes students with the fundamentals of biostatistics.

Unit I: Biostatistics
Definition and scope of biostatistics, Importance in biotechnological research, Statistical terms and symbols: Sample, data, primary and secondary data, parameter, Designing and methodology of an experiment.Sampling Techniques and Sampling Distributions: Methods of sampling- simple, random, systematic, stratified, cluster and non-random, Sampling distributions: Collection, representation and classification of data;
Methods of representation of statistical data: Tabular, graphical and diagrammatic presentation. Descriptive Statistics: Measures of central tendency: Arithmetic mean, median, mode, percentile;Dispersion: range, standard deviation. Probability and Probability Distributions: Introduction, Types of Probability: Classical, Relative, subjective, Axiomatic; Rules of probability: addition and multiplication rule; Introduction to Probability Distributions; Hypothesis testing: Setting up of hypothesis, type of errors in hypothesis, level of significance, Confidence intervals, One and two-tailed testing

Unit II: Introduction to Bioinformatics
Overview of Computational Biology: Definition and scope of Bioinformatics, Historical milestones and breakthroughs, Interdisciplinary nature of the field
Biological Databases: Introduction to databases, Types of biological databases: Primary, secondary, composite, Sequence, Structure, Genomic databases; Data formats: FASTA, Fastq, GenBank, PDB. Data Retrieval: Retrieval techniques and tools (Entrez)

Unit III: Sequence Analysis and Algorithms
Introduction to sequence alignment, Types of sequence alignment: Pairwise, multiple, global and local. **Sequence Search and Similarity:** BLAST and its types (Balstn, Blastp, Blastx, tBlastn, tBlastx), FASTA: theory and applications, E-value, bit score, and significance thresholds. **Introduction to phylogenetics**: Taxonomic relationship from molecular properties, Tree Topology, gene tree and tools for tree visualisation, Distance and character-based methods for phylogenetic tree construction; ClustalW, Phylip and Mafft

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-704
Course Title: Biostatistics and Bioinformatics
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hours

Unit IV: Structural Bioinformatics
Introduction, target identification strategies, predicting functionally important region from structure. Protein Structure Prediction: Homology modelling and threading techniques, Ab initio methods and their limitations. Protein-Ligand Interactions: Molecular docking principles, Applications in drug discovery and design

PRACTICALS:
1. Data collection and calculation of descriptive statistics.
2. Data Visualization using Excel
3. Introduction to Biological Databases like various NCBI databases.
4. Introduction to Data Formats (Fasta, Fastq etc)
5. Retrieve a specific DNA sequence from GenBank, perform a basic analysis, and annotate it using appropriate tools.
6. Sequence Alignment and Analysis
7. Align a set of related protein sequences using a multiple sequence alignment tool (e.g., ClustalW) and analyze the resulting alignment.
8. Perform a BLAST search using a protein query sequence against a suitable database, analyze the results, and identify potential homologs.
9. Introduction to Protein Databases, data retrieval.
10. Use a homology modeling tool to predict the 3D structure of a target protein based on a known template structure.
11. To visit the research institute/ University to get acquainted with advanced technique in related subject

SUGGESTED READING

1. "Bioinformatics: Sequence and Genome Analysis" by David W. Mount
2. "Introduction to Computational Biology: An Evolutionary Approach" by Bernhard Haubold and Thomas Wiehe
3. "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids" by Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison
4. Jonathan Pevsner. Bioinformatics and functional genomics. Wiley Blackwell, Third Edition, 2015
5. Des Higgins and William Taylor. Bioinformatics: Sequence, Structure, and databanks. Oxford University Press, 2001

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University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7th (Examination to be held in December 2025, 2026 and 2027)

MAJOR COURSE
Course Code: UMJBTT-704
Course Title: Biostatistics and Bioinformatics
Credits: 4 (3 Theory + 1 Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hours

6. Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1998)

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7 (Examination to be held in December 2025, 2026 and 2027)

MINOR COURSE
Course Code: UMIBTT-705
Course Title: Introduction to Nanobiotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME
To understand the nature and properties of nanomaterials. To provide scientific understanding of application of nanomaterials and nanotechnology in agriculture, health and environmental conservation.

Unit I:Introduction to nanomaterials: Development of nanobiotechnology - timelines and progress, overview. Various types of nanomaterials, Three-dimensional, two dimensional, one-dimensional and zero-dimensional nanomaterials , Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires

Unit II:Properties of nanomaterials: Synthesis of nanoparticles, Structural properties, chemical properties, surface functionalization, physical properties. Characterization of nanomaterials by various analytical methods, optical characterization and spectroscopy

Unit III:Nanobiotechnology in healthcare: Role of nanobiotechnology in the area of infectious & noninfectious diseases, Nanopharmaceuticals, Diagnosis, and biosensors, Delivery vehicles, biomedical applications of nanomaterials, targeted drug delivery

Unit IV:Nanobiotechnology for Agriculture: Nanotechnology based tools to enhance agricultural productivity, Nanobased Agri and Food Products, food preservation and toxicity, Nanopesticides and Nanofertilizers, Nanobiotechnology for Crop improvement, Nanotechnology for environment.

PRACTICALS
1. Synthesis of Ag nanoparticles using sodium borohydride (Creighton's method).
2. Synthesis of Au nanoparticles using citric acid (Lee –Meisel method)
3. Characterization of nanoparticles using UV spectrophotometry
4. Green synthesis of metal nanoparticles
5. Chemical synthesis of metal nanoparticles

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7 (Examination to be held in December 2025, 2026 and 2027)

MINOR COURSE
Course Code: UMIBTT-705
Course Title: Introduction to Nanobiotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

6. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGGESTED READINGS

1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), Christof M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.
4. 4. E. Gazit, Plenty of room for biology at the bottom: an introduction to bionanotechnology (Imperial College Press ; Distributed by World Scientific Pub. in the USA, London : Hackensack, NJ, 2007).
5. 5. G. E. J. Poinern, A laboratory course in nanoscience and nanotechnology (CRC Press, Taylor & Francis Group, Boca Raton, 2015).
6. 6.C. A. Mirkin, C. M. Niemeyer, Eds., More concepts and applications (Wiley-VCH, Weinheim, 2007), Nanobiotechnology.
7. J. Kim, Ed., Advances in nanotechnology and the environment (Pan Stanford, Singapore, 2012).

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 7 (Examination to be held in December 2025, 2026 and 2027)

MINOR COURSE
Course Code: UMIBTT-705
Course Title: Introduction to Nanobiotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
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Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN BIOTECHNOLOGY
BIOTECHNOLOGY COURSE
SEMESTER VIII

Semester	Types of Courses	Course code	Title	Credits
Sem- 8th	Major	UMJBTT-801	**Industrial Biotechnology**	4 (3+1)
	Major	UMJBTT-802	**Structural Biology**	4 (3+1)
Honours	Major	UMJBTT-803	**Advances in Biotechnology**	4 (3+1)
	Major	UMJBTT-804	**Vaccine and drug designing**	4 (3+1)
	Minor	UMIBTT-805	**Introduction to vaccine and drug designing**	4 (3+1)
				20 credits
			OR	
Sem- 8th	Major	UMJBTT-806	**Research Methodology**	4 (3+1)
Researc	Minor	UMIBTT-807	**Introduction to Research**	4 (3+1)
h			**Methodology**	
	research project SEC	USEBTP-808	**Research project**	12
				20 credits

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University of Jammu
Syllabi of Bio-Chemistry for FYUGP under CBCS as per NEP-2020
Semester 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-801
Course Title: Industrial Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory : 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

It combines science, engineering, and other biochemical processes in a novel way to produce products from a variety of industries, including food, chemicals, and bioenergy. The course gives an experimental demonstration of bioreactors as well as an introduction to their types and techniques of operation. Reactor architecture, yield-boosting techniques, and the microbial biofuels manufacturing process are all covered in detail. The course is beneficial to students in a variety of fields, including biotechnology, chemical engineering, food engineering, and pharmaceutical industries. It covers the current uses of bioprocessing, including the production of wine and cheese, antibiotics, vaccines, and other products. The primary emphasis of the training is on the applications is not just covering theory, the course primarily focuses on applications, giving students the opportunity to acquire real-world expertise.

UnitI: INTRODUCTION TO INDUSTRIAL BIOPROCESS

Industrial Biotechnology: Scope and importance, Commercial potential of Biotechnology in India. Historical overview of industrial fermentation process -traditional and modern Biotechnology. Industrial Fermentation- microorganisms, mode of operation, fermentation processes-pictorial representation. design of various commercial media for industrial fermentations – medium optimization Sterilization design techniques: heat sterilization of liquid media, filter sterilization of liquid media, sterilization of air.

Unit II : PRODUCTION OF PRIMARY AND SECONDARY METABOLITES

Modes of operation – batch, fed-batch and continuous cultivation, Simple unstructured kinetic models for microbial growth – Monod model, Thermal death kinetics of microorganisms. Growth of filamentous organisms and yeast; production of commercially important organic acids (citric acid); amino acids (glutamic acid) and alcohols (ethanol). Production processes for various classes of secondary metabolites: antibiotics: (penicillin), vitamins (Vit B12).Production of industrial enzymes such as proteases, amylases, lipases

UnitIII: MICROBES IN AGRICULTURE, FOOD AND PHARMACEUTICAL INDUSTRY

Production of biopesticide and biofertilizers.Microbial production of wine, beer and vinegar; bio preservatives (Nisin), cheese, vitamins; Bioflavours: microbial production of flavours and

fragrances and bio pigments: microbial pigments in textile and food industry. Production of recombinant proteins having therapeutic and diagnostic applications (insulin, human growth

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Practical: 25
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hormone), Production of recombinant vaccines (Hepatitis B vaccine, cholera vaccine), production of monoclonal antibodies. Genetic engineering of microorganisms for production of non-ribosomal peptides (NRPS) and polyketides (PKS), anticancer drugs.

Unit IV: BIOFUEL AND BIOENERGY

First generation biofuels-bioethanol – production mechanisms by microbes; Second generation biofuels-methane and hydrogen – production mechanisms by microbes; Factors affecting biogas yields. Third generation biofuels-biobutanol-biodiesel from algae; Fourth generation biofuels- solar to fuel method to produce biofuels. biogas, bio-refineries.Analysis of both current and future Indian regulations - directives on biofuels and bioenergy; Evaluation of different production alternatives to produce bioenergy. Evaluation of current and future R&D needs-legal framework to support sustainable development and increased use of biofuels; Government policies and programs with regard to biofuels and investment opportunities worldwide.

PRACTICAL:

1. Growth of bacteria - calculation of μ and Yield coefficient
2. Growth of yeast - calculation of μ and Yield coefficient.
3. Preparation of bioreactor; utilities of bioreactor operation. (Batch, Fed-batch and continuous).
4. Thermal Death kinetics
5. Batch reactor kinetics – estimation of reaction rate constant
6. To visit nearby research Institution/University/industry to get acquainted with advanced techniques in related subject

SUGESSTED READING

1. Ashok, M., & Rogers, K. (1998). Affinity Biosensors: Techniques and Protocols (Methods in Biotechnology). 1st edition. Humana Press.
2. Baltz, R.H., Demain, A.L. and Davies, J.E. (2010). Manual of Industrial Microbiology and Biotechnology. 3rd edition, ASM press, Washington DC.
3. Blanch, H. W., Clark, D. S., & Daugulis, A. J. (Eds.). (2017). Biotechnology for environmental protection in the pulp and paper industry. Springer.
4. Casida, L.E. (2022). Industrial Microbiology. 2nd edition. New Age International Pvt Ltd Publishers.
5. Chisti, Y. (2018). Bioprocess engineering: Basic concepts (3rd ed.). Academic Press.

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Course Code: UMJBTT-801
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Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory : 75
Practical: 25
Duration of Examination: 3 hrs

6. Cruger, W. and Cruger, A. (2005). A Textbook of Industrial Microbiology. 2nd edition. Panima Publishing Corporation.
7. Crueger, W., Cruegen, A. and Aneja, K.R. (2017). A textbook of Industrial Microbiology. 3rd edition. Medtech.
8. Demain, A. L., & Davies, J. (1999). Manual of Industrial Microbiology and Bbiotechnology, (3rd edition); ASM Press, Washington DC.
9. Flickinger, M. C. (Ed.). (2017). Encyclopedia of industrial biotechnology. Wiley.
10. Klefenz, H. (2002). Industrial pharmaceutical biotechnology. 1st edition. John Wiley & Sons.
11. Lee, S. Y., and Kim, H. U. (2015). Systems metabolic engineering: Paradigm for bioprocess development. Annual Review of Chemical and Biomolecular Engineering, 6, 77-104.
12. Lee, S. Y., Nielsen, J., and Stephanopoulos, G. (2017). Industrial biotechnology: Products and processes. 1st edition. John Wiley & Sons.
13. Liu, S. (2020). Bioprocess engineering: Kinetics, sustainability, and reactor design. 3rd edition. Academic Press.
14. Moo-Young, M., Butler, M., Webb, C., and Moreira, A. R. (Eds.). (2016). Comprehensive biotechnology. (3rd edition). Industrial Biotechnology). Elsevier.
15. Nielsen, J., & Keasling, J. D. (2016). Engineering cells for biofuels production. In Metabolic engineering (pp. 367-394). Springer.
16. Okafor, N. (2007). Modern Industrial microbiology and biotechnology. 1st edition. CRC Press.
17. Presscott and Dunn's (2004). Industrial microbiology. 4th edition. CBS Publisher.
18. Rehm, H. J., & Reed, G. (2019). Biotechnology: A multi-volume comprehensive treatise (2nd ed., Vol. 11: Industrial Biotechnology). Wiley-VCH.
19. Waites, M. J., Morgan, N. L., Rockey, J. S., & Higton, G. (2001). Industrial microbiology: An introduction. 1st edition. Wiley- Blackwell Publishing.

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Semester 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-801
Course Title: Industrial Biotechnology
Credits : 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory : 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	yllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	½ Hours	15
External Theory End Semester	100%	3 Hours	60
Daily Practical Evaluation	-	-	10 (Based on Daily Performance only)
Final Practical Exam	-	-	15 (10 Marks Test & 5 Marks Viva

A) **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**
B) **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
   c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

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MAJOR COURSE
Course Code: UMJBTT-802
Course Title: Structural Biology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

The course will educate students on the structural units of biological macromolecules, their hierarchies, and the basics of structural biology techniques. It will cover the molecular dynamics and case studies, focusing on how biological macromolecules are generated, folded, and functional. This knowledge will prepare students for advanced courses in structural biology, macromolecular crystallography, cryo-electron microscopy, nuclear magnetic resonance, structure-based drug designing, and protein engineering; ultimately opening up the door to modern research-related courses in drug design and macromolecule-based engineering.

Unit I: Introduction to Structural Biology

Overview of structural biology and its significance in understanding biological macromolecules; Basics of biomolecular structure, including proteins, nucleic acids, and carbohydrates; Introduction to the use of bioinformatics in structural biology; Introduction to various techniques used in structural biology, such as NMR spectroscopy.

Unit II: Techniques in Structural Biology

Principles and applications of X-ray crystallography for macromolecular structure determination; NMR spectroscopy and its role in elucidating the three-dimensional structures and dynamics of proteins and nucleic acids; Cryo-electron microscopy (Cryo-EM) and its recent advances in high-resolution structural studies.

Unit III: Protein Structure and Function

Protein structure and its hierarchical organization, including primary, secondary, tertiary, and quaternary structures; Enzyme structure and function; Protein-ligand interactions, including receptor-ligand binding, drug discovery; Introduction to PDB data, RCSB, reading PDB files, 3D structure Visualization of macromolecules

Unit IV: Nucleic Acid Structure

Nucleic acid structure, including DNA and RNA, and their role in genetic information storage and transfer; Structural biology of macromolecular complexes, such as ribosomes, spliceosomes, and viral capsids; Structural aspects of membrane proteins and their functional

roles; Emerging trends in structural biology, including structural genomics, structural bioinformatics including EMBOSS and BLAST, and drug design.

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Semester 8th (Examination to be held in May 2026, 2027 and 2028

MAJOR COURSE

Course Code: UMJBTT-802

Course Title: Structural Biology

Credits: 4 (3Theory+1Practical)

Total No. of Lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical: 25

Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

1. **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**
2. **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
   c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

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Semester 8th (Examination to be held in May 2026, 2027 and 2028

MAJOR COURSE
Course Code: UMJBTT-802
Course Title: Structural Biology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS:

1. Compare the protein sequences using BLASTp.
2. Compare the sequence of gene and protein using BLASTx and tBLASTn.
3. Download the crystal structure of protein from PDB.
4. Download the crystal structure of protein from RCSB.
5. Compare the sequences of the amino acid sequence of a particular gene using EMBOSS bioinformatics tool.
6. Find the conserved sequences of the above amino acid sequences.
7. Find the hotspots of the above amino acid sequences.
8. Find the Percentage similarity in the above sequence.
9. Find the Percentage identity in the above sequence.
10. Create a sequence logo using Web logo database of the above sequences.

SUGGESTED READING

1. Compeau, P., and Pevzner, P. (2014). Bioinformatics Algorithms: Sequence Analysis, Genome Rearrangements, and Phylogenetic Reconstruction.1st Edition.
2. Branden, C., & Tooze, J. (1999). Introduction to Protein Structure. 2nd edition. Garland Science.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell. 6th editio. Garland Science.
4. Lesk, A. M. (2017). Introduction to Protein Science: Architecture, Function, and Genomics. 2nd edition. Oxford University Press.
5. Perutz, M. F. (1998). Protein Structure: New Approaches to Disease and Therapy. 2nd edition. W.H. Freeman.
6. Richard, J. P. (2018). Quantitative Biological Spectroscopy. CRC Press.
7. Bourne, Y., & Boulot, G. (2010). Protein-Ligand Interactions: From Molecular Recognition to Drug Design. Academic Press.
8. Doonan, J. H., & Trentham, D. R. (2015). Calcium: The Molecular Basis of Calcium Action in Biology and Medicine. Springer.
9. Wallace, B. A. (2014). Synchrotron Radiation in Structural Biology. CRC Press.
10. Tilton, R. F., & Moustakas, D. (2014). X-ray Synchrotron Radiation for Biophysical and Biochemical Studies on Macromolecules. Cambridge University Press.

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-803
Course Title: Advances in Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME

The course provides an overview of advances in Biotechnology such as Sytem biology, Artificial Intelligence, Stem Cells and Regenerative Medicine, Bioprinting & Biofabrication. After successful completion of course, the student will have extensive theoretical and practical knowledge on System Biology, Artificial Intelligence, Stem cell and Regenerative Medicine; and Bioprinting & Biofabrication. Students will also be able to identify interactions between the components of biological systems and understand how these interactions give rise to the physiological function of the system. Student will get insight about basics of 3D printing and devices used for biofabrication, and the introduction to 3D design. In addition, the students will be motivated to take up higher studies in Computer Science and Artificial Intelligence.

Unit I: Artificial Intelligence & Machine learning

Artificial Intelligence: Foundation, History and Evolution of AI, AI in the Real World, Ethics in AI and Social Impact, Introduction to Python, Overview to Machine Learning and Deep learning, Supervised vs. Unsupervised Learning, Brief idea of Chatbots and Language Models, Application of AI in Biotechnology.

Unit II: Stem Cells and Regenerative Medicine

Pluripotent stem cells, embryonic stem cells derrived from human and other species, Concept of Induced pluripotent stemcells, differentiated stem cell and its type, applications of Human pluripotent stem Cells in neuronal, ocular and cardiovascular diseases and cancer management and their treatment, Stem cell gene therapy.

Unit III: Bioprinting and Biofabrication

Introduction to Biofabrication and 3D-Bioprinting: Technologies and Tools, Biomaterials for 3D Bioprinting, 3D modelling basics, Bioprinting with cells, Development of bioinks, Opportunities & Challenges of 3D bioprinting, Ethical and regulatory issues

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Course Title: Advances in Biotechnology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit IV: Systems Biology

Introduction to systems biology: Key concepts of systems biology- dynamic systems, network, self-organization, emergent properties, homeostasis, robustness. Genotype-phenotype mapping, Gene regulation networks, Metabolic networks and flux analysis. Methods and tools for Systems Biology. Application of systems biology in modern medicines.

PRACTICALS:

1. Visit to Institutes and Universitiesworking on Stem cells, AI, Bioprinting and System Biology
2. Culturing of human lymphocytes.
3. Hands on training on AI software such as ChatGPT
4. Use of AI in science communication
5. Use of AI in disease detection using PlantVillage app.
6. Hands on training on system biology modeling software

SUGESSTED READING

1. Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig (2009) United Kingdom: Prentice Hall.
2. Artificial Intelligence: Foundations of Computational Agents" by David Poole and Alan Mackworth (2023). India: Cambridge University Press.
3. An Introduction to Systems Biology: Design Principles of Biological Circuits (Chapman & Hall/CRC Mathematical and Computational Biology) by Uri Alon. Copyright 2020. ISBN 9781439837177. 342 Pages. Published August 7, 2019 by Chapman & Hall
4. Valcourt, J. R. (2017). Systematic: How Systems Biology Is Transforming Modern Medicine. United States: Bloomsbury Publishing.
5. 3D Printing and Biofabrication.(2018) by Aleksandr Ovsianikov, Vladimir Mironov, James Yoo Germany: Springer International Publishing. ISBN:9783319454436.
6. Essentials of 3D Biofabrication and Translation by Anthony Atala and James J Yoo (2015) Netherlands: Elsevier Science.

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Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

7. Stem Cell Biology and Regenerative Medicine by Charles Durand, Pierre Charbord. (2021). Denmark: River Publishers.
8. Stem Cells in Regenerative Medicine: Science, Regulation and Business Strategies by Alain A. Vertes, Arnold I. Caplan, Lee E. Babiss, Nasib Qureshi. (2015). Germany: Wiley.

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

1. **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**

2. **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
   a) External End Semester Theory Examination will have two sections (A & B).
   b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
   c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-804
Course Title: Vaccine and Drug designing
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME
Upon completion of the course, students will demonstrate a thorough knowledge of immunity, types of vaccines, and drug designing techniques. Students will acquire skills in cell culture techniques, purification, concentration methods, and quality control assays for vaccine production. Students will develop the ability to identify potential drug targets (receptors, enzymes, ion channels) and conduct high-throughput screening for hit identification. Students will understand the principles of pharmacokinetics and various formulation strategies for effective drug delivery via different routes. Students will be familiar with emerging technologies like in silico approaches, reverse vaccinology, and nanotechnology, and understand their applications in vaccine and drug development.

Unit I: Introduction to Immunity and Vaccines
Immunity, Active and Passive Immunity, Development of active immunity, Vaccines, Challenges to Vaccine development. Vaccine Types and Design: Live attenuated vaccines, Inactivated vaccines, Subunit vaccines, Nucleic acid-based vaccines: DNA and mRNA vaccines.

Unit II: Vaccination development and Drug Discovery
Cell culture techniques: Mammalian cell lines, propagation and harvesting; Purification and concentration methods for vaccine production; Quality control assays: Potency, sterility, and stability testing; Adjuvants and formulation techniques for enhancing vaccine efficacy. Drug Targets and Screening: Identification of drug targets. High-throughput screening methods.

Unit III: Drug Designing and Delivery
Drug Designing Techniques: Structure-based drug design, Ligand-based drug design and docking studies;.Combinatorial chemistry and fragment-based drug design. Drug Formulation and Delivery: Pharmacokinetics: Absorption, distribution, metabolism, excretion (ADME), Formulation strategies for oral, parenteraland topical drug delivery, Controlled release systems: Polymers, liposomes, nanoparticles.

Unit IV: Advanced Topics in Vaccine and Drug Designing
Emerging Technologies and Trends: In silico approaches, reverse vaccinology, multiple epitome vaccines (MEVs), Nanotechnology in drug delivery and vaccine development. Personalized Medicine in Drug Design and Vaccines. Pharmacogenomics and its role in individualized treatment.

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MAJOR COURSE
Course Code: UMJBTT-804
Course Title: Vaccine and Drug designing
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS:
1. Cultivate and inactivate a model microorganism for vaccine production.
2. Quantify antibody titers in a serum sample using Enzyme-Linked Immunosorbent Assay (ELISA).
3. Perform a simple colorimetric assay to screen potential drug candidates.
4. Observe and quantify binding interactions between antigens and antibodies.
5. Assess the cytotoxic effects of a drug compound on a cell line/Anti-microbial activity.
7. Perform virtual docking studies to predict the binding affinity of a drug to a target.
8. Introduce a plasmid carrying a therapeutic gene into bacterial cells.
9. Prepare a basic nanoparticle formulation for drug delivery applications.

SUGESSTED READING

1. "Vaccines" by Plotkin, Orenstein, and Offit (2017) Publisher: Elsevier
2. "Vaccine Development and Manufacturing" by Emily P. Wen, Daniel M. Spearman (2014) Publisher: John Wiley & Sons
3. "Principles of Drug Action: The Basis of Pharmacology" by William B. Pratt and Paul C. MacDonald (2011) Publisher: Churchill Livingstone
4. "Introduction to Drug Disposition and Pharmacokinetics" by Stephen H. Curry and Robin Whelpton (2017) Publisher: Wiley-Blackwell
5. "Immunology" by Kuby, Owen, and Punt (2018) Publisher: Macmillan Learning
6. "Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. H. Lichtman, and Shiv Pillai (2014) Publisher: Saunders
7. "Immunotherapy: Basic Concepts and Applications" by Gabriela Riemekasten and Thomas Häupl (2017) Publisher: Springer
8. "Molecular Modeling of Proteins" by Andreas Kukol (2008) Publisher: Humana Press
9. "Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation" by Justin M. Clark, Howard L. McLeod (2013) Publisher: Academic Press
10. "Ethics in Clinical Research: A Focus on Ebola" by Mark Sheehan, Sarah Hawkes, and Richard Sullivan (2017) Publisher: Springer.

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-804
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Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**

B) **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**
a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
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Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MINOR COURSE
Course Code: UMIBTT-805
Course Title: Introduction to Vaccine and Drug designing
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME
Upon completion of the course, students will demonstrate a thorough knowledge of immunity, types of vaccines, and drug designing techniques. Students will acquire skills in cell culture techniques, purification, concentration methods, and quality control assays for vaccine production. Students will develop the ability to identify potential drug targets (receptors, enzymes, ion channels) and conduct high-throughput screening for hit identification. Students will understand the principles of pharmacokinetics and various formulation strategies for effective drug delivery via different routes. Students will be familiar with emerging technologies like in silico approaches, reverse vaccinology, and nanotechnology, and understand their applications in vaccine and drug development.

Unit I: Introduction to Immunity and Vaccines
Immunity, Active and Passive Immunity, Development of active immunity, Vaccines, Challenges to Vaccine development. Vaccine Types and Design: Live attenuated vaccines, Inactivated vaccines, Subunit vaccines, Nucleic acid-based vaccines: DNA and mRNA vaccines.

Unit II: Vaccination development and Drug Discovery
Cell culture techniques: Mammalian cell lines, propagation and harvesting; Purification and concentration methods for vaccine production; Quality control assays: Potency, sterility, and stability testing; Adjuvants and formulation techniques for enhancing vaccine efficacy. Drug Targets and Screening: Identification of drug targets. High-throughput screening methods.

Unit III: Drug Designing and Delivery
Drug Designing Techniques: Structure-based drug design, Ligand-based drug design and docking studies;. Combinatorial chemistry and fragment-based drug design. Drug Formulation and Delivery: Pharmacokinetics: Absorption, distribution, metabolism, excretion (ADME), Formulation strategies for oral, parenteral and topical drug delivery, Controlled release systems: Polymers, liposomes, nanoparticles.

Unit IV: Advanced Topics in Vaccine and Drug Designing
Emerging Technologies and Trends: In silico approaches, reverse vaccinology, multiple epitome vaccines (MEVs), Nanotechnology in drug delivery and vaccine development. Personalized Medicine in Drug Design and Vaccines. Pharmacogenomics and its role in individualized treatment.

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MINOR COURSE
Course Code: UMIBTT-805
Course Title: Introduction to Vaccine and Drug designing
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICALS:

1. Cultivate and inactivate a model microorganism for vaccine production.
2. Quantify antibody titers in a serum sample using Enzyme-Linked Immunosorbent Assay (ELISA).
3. Perform a simple colorimetric assay to screen potential drug candidates.
4. Observe and quantify binding interactions between antigens and antibodies.
5. Assess the cytotoxic effects of a drug compound on a cell line/Anti-microbial activity.
7. Perform virtual docking studies to predict the binding affinity of a drug to a target.
8. Introduce a plasmid carrying a therapeutic gene into bacterial cells.
9. Prepare a basic nanoparticle formulation for drug delivery applications.

SUGESSTED READING

1. "Vaccines" by Plotkin, Orenstein, and Offit (2017) Publisher: Elsevier
2. "Vaccine Development and Manufacturing" by Emily P. Wen, Daniel M. Spearman (2014) Publisher: John Wiley & Sons
3. "Principles of Drug Action: The Basis of Pharmacology" by William B. Pratt and Paul C. MacDonald (2011) Publisher: Churchill Livingstone
4. "Introduction to Drug Disposition and Pharmacokinetics" by Stephen H. Curry and Robin Whelpton (2017) Publisher: Wiley-Blackwell
5. "Immunology" by Kuby, Owen, and Punt (2018) Publisher: Macmillan Learning
6. "Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. H. Lichtman, and Shiv Pillai (2014) Publisher: Saunders
7. "Immunotherapy: Basic Concepts and Applications" by Gabriela Riemekasten and Thomas Häupl (2017) Publisher: Springer
8. "Molecular Modeling of Proteins" by Andreas Kukol (2008) Publisher: Humana Press
9. "Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation" by Justin M. Clark, Howard L. McLeod (2013) Publisher: Academic Press
10. "Ethics in Clinical Research: A Focus on Ebola" by Mark Sheehan, Sarah Hawkes, and Richard Sullivan (2017) Publisher: Springer.

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University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MINOR COURSE
Course Code: UMIBTT-805
Course Title: Introduction to Vaccine and Drug designing
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

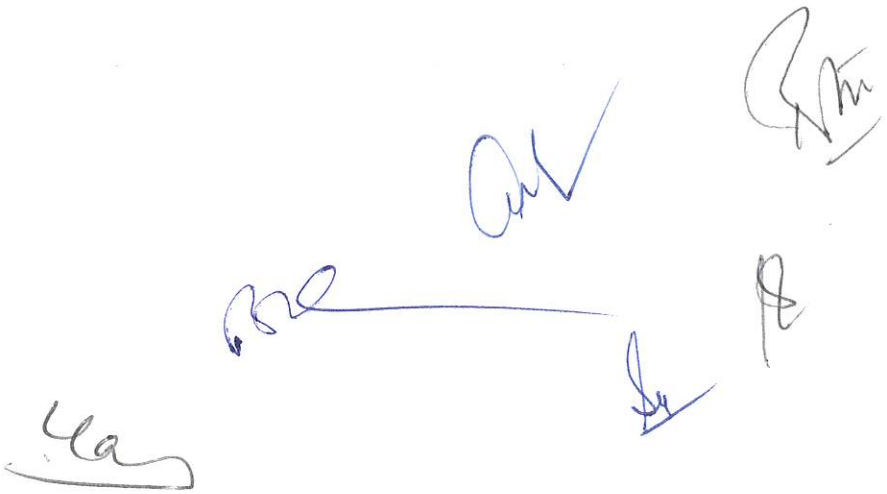
Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) **Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours**

B) **External End Semester Examination: (60 Marks) Time Allotted 3 Hours**

a) External End Semester Theory Examination will have two sections (A & B).
b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Ethical Authorship and Plagiarism Research Dissemination and Publication, Reviewing the Research Process



University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-806
Course Title: Research methodology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOME
The course provides an introduction to Research Methodology. After successful completion of course, the student will be able to demonstrate a solid understanding of research methodology and its application in various disciplines. Students will be able to design and execute research projects using appropriate methods and techniques, analyze and interpret research data using suitable statistical tools and software. Students can apply ethical practices in research and can explain the significance of intellectual property rights and their role in promoting creativity and innovation.

Unit I: Introduction to Research Methodology
Research, Types of Research: Exploratory, Descriptive, Analytical, Experimental, Empirical and Deductive reasoning; Research Problem Formulation; Research Design and Sampling, Data Collection Methods: Surveys, Interviews; Observations; Data Sources: Primary and Secondary; Data Analysis Techniques: Qualitative vs. Quantitative; Research Ethics and Integrity

Unit II: Research Planning and Proposal
Research Hypothesis, Literature Review; Research Questions and Objectives, Research Variables and Measurement, Research Proposal Writing: Structure and Components Budgeting and Resource Planning, Ethical Considerations in Research Proposals, Peer Review and Feedback,

Unit III: Data Collection and Analysis
Observational Research: Methods and Recording, Experimental Design and Control Groups Qualitative Data Collection: Interviews, Focus Groups, and Content Analysis Data Entry and Management: Descriptive Statistics and Data Visualization, Inferential Statistics: Hypothesis Testing and Confidence Intervals Regression Analysis.

Unit IV: Research Reporting and Communication
Research Manuscript Writing, Proper Citation and Referencing Styles; Creating Effective Figures and Tables; Oral Presentation Skills: Preparing Research Presentations and Slides,

Ethical Authorship and Plagiarism Research Dissemination and Publication, Reviewing the Research Proce

University of Jammu
Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MAJOR COURSE
Course Code: UMJBTT-806
Course Title: Research methodology
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

PRACTICAL
1 Demonstrate and literature survey using different online platforms.
2. Demonstrate use Microsoft office in data analysis.
3. Demonstrate graph preparation using software (Microsoft excel, origin, graph pad)
4. Discuss any research article to explain the elements of research paper
5. Demonstrate the use of PPT in poster preparation.
6. Demonstrate the citation software such and Mendeley and Zotero

SUGGESTED READING

1. Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar
2. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell
3. Research Methodology: Methods and Techniques" by C.R. Kothari
4. Research Methodology: A Step-by-Step Handbook for Beginners" by Dr. R. Kumar

NOTE FOR PAPER SETTING

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External Practical	-	-	**15**

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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020
Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

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Course Title: Research methodology
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Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020

Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

MINOR COURSE

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Duration of Examination: 3 hrs

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Research Manuscript Writing, Proper Citation and Referencing Styles; Creating Effective Figures and Tables; Oral Presentation Skills: Preparing Research Presentations and Slides,

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Total No. of Lectures: Theory: 45 hours

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Duration of Examination: 3 hrs

PRACTICAL

1 Demonstrate and literature survey using different online platforms.
2. Demonstrate use Microsoft office in data analysis.
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4. Discuss any research article to explain the elements of research paper
5. Demonstrate the use of PPT in poster preparation.
6. Demonstrate the citation software such and Mendeley and Zotero

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University of Jammu

Syllabi of Biotechnology for FYUGP under CBCS as per NEP-2020

Semester – 8th (Examination to be held in May 2026, 2027 and 2028)

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Course Code: UMIBTT-807

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University of Jammu
Syllabi of Biotechnology for FYUP under CBCS as per NEP-2020
Semester – VIII (Research)
(Examination to be held in May 2026, 2027 & 2028)
DISSERTATION

Course Code : USEBTP-808
Course Title : Dissertation
Credits : 12 (8 Dissertation + 4 Viva)
Maximum Marks: 300
I) Dissertation: 200
II) Presentation and Viva: 100

Objectives and Expected Learning Outcomes

The primary objective of this project work course is to facilitate the application of theoretical knowledge in solving real-world problems, fostering research competencies among undergraduate students. Through hands-on projects, students will develop critical thinking skills and proficiency in data analysis. The course aims to cultivate a problem-solving mindset, enhance self-directed learning, and provide a platform for the acquisition of advanced knowledge through project-based study. Upon completion of the project work course, students will gain practical experience in applying academic concepts to real-life situations. They will develop strong research competencies, including data collection and analysis, literature review skills, and will be able to draw meaningful conclusions. Additionally, students will hone their communication, teamwork, and time management skills, preparing them for the challenges of their future careers or advanced academic pursuits. Overall, the course aims to equip students with the necessary skills and knowledge to thrive in professional and research-oriented environments.

Scheme of Research Project and Dissertation

Allotment of Supervisor

Each student shall carry out a project work in one of the broad areas of Biotechnology in the semester VIII under the supervision of the faculty of the department.

Research Work and Dissertation Writing:

1. After the allotment of supervisor, the student will carry out the proposed research work (field/lab.) and post-completion of the research work, students will write the dissertation. During the field/lab work and compilation of the dissertation, the student will work under continuous guidance of the supervisor who will maintain the regular attendance of the student.

2. Student will submit 2 hard copies of the final dissertation in the department along with a soft copy of the same.

University of Jammu
Syllabi of Biotechnology for FYUP under CBCS as per NEP-2020
Semester – VIII (Research)
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DISSERTATION

Course Code : USEBTP-808
Course Title : Dissertation
Credits : 12 (8 Dissertation + 4 Viva)
Maximum Marks: 300
I) Dissertation: 200
II) Presentation and Viva: 100

Format for dissertation is given below:

The dissertation should be presented chapter wise. Each chapter will have a precise title as given below. A chapter can be subdivided into sections, and sub-section so as to present the content discretely and with due emphasis.

Abstract

Content Page

List of Figures

List of Tables

Acknowledgement

List of Abbreviations

Chapter 1: Introduction:

It shall justify and highlight the problem posed, define the topic and explain the aim and scope of the work presented in the dissertation. This chapter also include objective of the research work. It may also highlight the significant contributions from the investigation.

Chapter 2: Review of Literature:

This Chapter presents a critical appraisal of the previous work published in the literature pertaining to the topic of the investigation.

Chapter 3: Material and Methods:

This chapter deals with a detail methodology/technique/theory by which researcher used to carry out the research work.

Chapter 4: Results and Discussion:

This chapter includes a thorough evaluation of the investigation carried out and brings out the contributions from the study. The discussion shall logically lead to inferences and conclusions as well as scope for possible further future work.

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Semester – VIII (Research)
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Maximum Marks: 300
I) Dissertation: 200
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Chapter 5: Summary and Conclusion:

A brief report of the work carried out shall form the first part of the Chapter. Conclusions derived from the logical analysis presented in the results and discussions chapter shall be presented and clearly enumerated, each point stated separately. Scope for future work should be stated lucidly in the last part of this chapter.

Chapter 6: References/Bibliography:

The candidates shall follow the style for references as mentioned below. For journal: Loizides, M., Georgiou, A.N., Somarakis, S., Witten, P.E. and Koumoundouros, G., 2014. A new type of lordosis and vertebral body compression in G ilthead sea bream, S parus aurata L.: aetiology, anatomy and consequences for survival. Journal of Fish Diseases, 37(11), pp.949-957.

TYPE -SETTING, TEXT PROCESSING AND PRINTING

1. The text shall be printed employing using a standard text processor. The standard font shall be Times New Roman of 12 pts with 1.5 line spacing.

2. Binding Spiral or hard Binding

3. Front Covers: The front covers shall contain the following details: a. Full title of dissertation in 6 mm/22 point's size font properly centered and positioned at the top. b. Full name of the candidate in 4.5 mm 15 point's size font properly centered at the middle of the page. c. 40 mm wide replica of the College and University emblems followed by the name of department, name of the College, name of the University and the year of submission, each in a separate line and properly centered and located at the bottom of page.

4. Title Sheet: This shall be the first printed page of the thesis and shall contain the submission statement: the dissertation submitted in partial fulfilment of the requirements of the B.Sc. (Honours) Biotechnology, the name, Registration No. and University Roll No. of the candidate, name(s) of the Supervisor, Department, College, University and year of submission. 5. A Declaration of Academic Honesty and Integrity by Candidate: A declaration of Academic honesty and integrity is required to be included along with every dissertation. The format of this declaration is given in Annexure-I attached. 6. Certificate from Supervisor (Annexure-II):

University of Jammu
Syllabi of Biotechnology for FYUP under CBCS as per NEP-2020
Semester – VIII (Research)
(Examination to be held in May 2026, 2027 & 2028)
DISSERTATION

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Course Title : Dissertation
Credits : 12 (8 Dissertation + 4 Viva)
Maximum Marks: 300
I) Dissertation: 200
II) Presentation and Viva: 100

7. Abstract: The 500-word (maximum) abstract shall highlight the important features of the dissertation.

Evaluation of the dissertation: 1. The project report/dissertation shall be evaluated by the external expert from other University/Colleges to be nominated by the Principal out of the panel supplied by the College Research Committee (CRC) in accordance with Guidelines for FYUGP issued by the University of Jammu. 2. The students shall be declared pass in the research project course if she/he secures minimum 40% marks (Dissertation and viva).