UNIVERSITY OF JAMMU

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

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(25/Oct./Adp./116)

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 for **Post Graduate Programme** in **Biotechnology** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Biotechnology	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

One Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Biotechnology	Semester-I	December 2026, 2027 and 2028
	Semester-II	May 2027, 2028 and 2029

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

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/11178-189
Dated: 18/10/25

Copy for information and necessary action to:

1. Dean, Faculty of Life- Science
2. Convener, Board of Studies in Biotechnology
3. Director, CITES&M, University of Jammu for directing the concerned to upload the notification on University Website
4. All members of the Board of Studies
5. Joint Registrar (Evaluation/P.G. Exam.)
6. Programmer, Computer Section, Examination Wing

10/10/25
Joint Registrar (Academic)

9/10/25 9/10/25

M.Sc. Biotechnology (jaeyFL#42G#qCSS)

2 years programme as per NEP-2020

Syllabus for the 2 years PG Programme as per NEP-2020

Total credits: 104 credits

SEMESTER I SCHEME

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2BTTC101	Fundamentals of Molecular Biology	4
P2BTTC102	Cellular Biology	4
P2BTTC103	Basics of Biochemistry & Metabolism	4
P2BTPC104	Laboratory course based on Molecular Biology	2
P2BTPC105	Laboratory course based on Cellular Biology	2
P2BTPC106	Laboratory course based on Basics of Biochemistry & Metabolism	2
	Electives*	
P2BTTE107	Molecular Virology and Vaccinology	4
P2BTTE108	Analytical techniques in Biology	4
P2BTTE109	Micronutrients and Mammalian Hormones	4
P2BTPE110	Laboratory course based on the Molecular Virology and Vaccinology	2
P2BTPE111	Laboratory course based on the Analytical Techniques in Biology	2
P2BTPE112	Laboratory course based on the Micronutrients and Hormones	2
TOTAL		24

***A student has to select one elective course from the given elective courses**

Syllabus for the 2 years PG Programme as per NEP-2020

SEMESTER II SCHEME

COURSE CODE	PAPER	CREDITS
Core Courses		
P2BTTC201	Recombinant DNA Technology	4
P2BTTC202	Enzymes and Enzyme Technology	4
P2BTTC203	Principles of Microbiology	4
P2BTPC204	Laboratory course based on Recombinant DNA Technology	2
P2BTPC205	Laboratory course on Enzymes and Enzyme Technology	2
P2BTPC206	Laboratory course based on Principles of Microbiology	2
Electives*		
P2BTTE207	Applied Biotechnology	4
P2BTTE208	Human Disease Biology	4
P2BTTE209	Proteomics and metabolomics	4
P2BTPE210	Laboratory course based on Applied Biotechnology	2
P2BTPE211	Laboratory course based on Human Disease Biology	2
P2BTPE212	Laboratory course based on Proteomics and Metabolomics	2
	Vocational course**	
P2BTVC251	Industrial Technology	4
P2BTVC252	Diagnostic Techniques in Biochemistry and Microbiology	4
TOTAL		24

***A student has to select one elective course from the given elective courses**

****Student who wish to opt out after oner year of PG course has to compulsory opt for a vocational course P2BTVC251 or P2BTVC252.**

Syllabus for the 2 years PG Programme as per NEP-2020

SEMESTER III SCHEME

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2BTTC301	Bioprocess Technology	4
P2BTTC302	Fundamentals of Genetics and Genomics	4
P2BTTC303	Basic Environmental Biotechnology	4
P2BTTC304	Fundamentals of Biostatistics and Bioinformatics	2
P2BTPC305	Laboratory course based on Bioprocess Engineering	2
P2BTPC306	Laboratory course based on fundamentals of Genetics and Genomics	2
P2BTPC307	Laboratory course based on Fundamentals of Biostatistics and Bioinformatics	2
	Electives*	
P2BTTE308	Artificial Intelligence in Biology	2
P2BTTE309	Computational Genomics	2
P2BTTE310	Microbiomics	2
P2BTPE311	Laboratory course based on Artificail intelligence in Biology	2
P2BTPE312	Laboratory course based on Computational Genomics	2
P2BTPE313	Laboratory course based on Microbiomics	2
P2BTMO351	**MOOCS course***	4
TOTAL		28

***A student has to select one elective course from the given elective courses**

Syllabus for the 2 years PG Programme as per NEP-2020

SEMESTER IV SCHEME

COURSE CODE	PAPER	CREDITS
Core Courses		
P2BTTC401	Immunology and Immunotechnology	4
P2BTTC402	Fundamentals of Plant Biotechnology	2
P2BTTC403	Applied Animal Biotechnology	2
P2BTPC405	Laboratory course based on Immunology and Immunotechnology	2
P2BTPC406	Laboratory course based on Fundamentals of Plant Biotechnology and Applied Animal Biotechnology	2
Electives*		
P2BTTE407	Bioentrepreneurship	2
P2BTTE408	IPRs and Bioethics	2
P2BTTE409	Research Methodology and Scientific Communication	2
P2BTTE410	Functional Nutraceutical	2
Research (thesis/project/patent)		
P2BTRC411	Research Project	16
TOTAL		30

***A student has to select one elective course from the given elective courses**

Syllabi framework for 2 years PG Programme in Biotechnology

S. no	Course no.	Course title	No of credits	Credit level	Credit point	Course type Core/ elective/any other	Marks Theory	Marks Practical	Nature of course Global	National	Regional	skill	Swayam/ MOOC	Vocational Course	Research project/summer internship/ Dissertation
1	**P2BTTC101**	Fundamentals of Molecular Biology	4	6.5	26	core	100		✓	✓	✓	✓			
2	**P2BTTC102**	Cellular Biology	4	6.5	26	core	100		✓	✓	✓	✓			
3	**P2BTTC103**	Basics of Biochemistry & Metabolism	4	6.5	26	core	100		✓	✓	✓				
4	**P2BTPC104**	Laboratory course based on Molecular Biology	2	6.5	13	core		50	✓	✓	✓	✓			
5	**P2BTPC105**	Laboratory course based on Cellular Biology	2	6.5	13	core		50	✓	✓	✓	✓			
6	**P2BTPC106**	Laboratory course based on Basics of Biochemistry & Metabolism	2	6.5	13	core		50	✓	✓	✓	✓			
7	**P2BTTE107**	Molecular Virology and vaccinology	4	6.5	26	Elective	100		✓	✓	✓	✓			
8	**P2BTTE108**	Analytical techniques in Biology	4	6.5	26	Elective	100		✓	✓	✓	✓			
9	**P2BTTE109**	Micronutrients and Mammalian Hormones	4	6.5	26	Elective	100		✓	✓	✓	✓			
10	**P2BTPE110**	Laboratory course based on the Molecular Virology and Vaccinology	2	6.5	13	Elective		50	✓	✓	✓	✓			
11	**P2BTPE111**	Laboratory course based on the Analytical Techniques in Biology	2	6.5	13	Elective		50	✓	✓	✓	✓			
12	**P2BTPE112**	Laboratory course based on the Micronutrients and Hormones	2	6.5	13	Elective		50	✓	✓	✓	✓			
13	**P2BTTC201**	Recombinant DNA Technology	4	6.5	26	core	100		✓	✓	✓	✓			
14	**P2BTTC202**	Enzymes and Enzyme Technology	4	6.5	26	core	100		✓	✓	✓	✓			
15	**P2BTTC203**	Principles of Microbiology	4	6.5	26	core	100		✓	✓	✓	✓			
16	**P2BTPC204**	Laboratory course based on Recombinant DNA Technology	2	6.5	13	core		50	✓	✓	✓	✓			
17	**P2BTPC205**	Laboratory course on Enzymes and Enzyme Technology	2	6.5	13	core		50	✓	✓	✓	✓			
18	**P2BTPC206**	Laboratory course based on Principles of Microbiology	2	6.5	13	core		50	✓	✓	✓	✓			
19	**P2BTTE207**	Applied Biotechnology	4	6.5	26	Elective	100		✓	✓	✓	✓			
20	**P2BTTE208**	Human Disease Biology	4	6.5	26	Elective	100		✓	✓	✓				
21	**P2BTTE209**	Proteomics and metabolomics	4	6.5	26	Elective	100		✓	✓	✓	✓			
22	**P2BTPE210**	Laboratory course based on Applied Biotechnology	2	6.5	13	Elective		50	✓	✓	✓	✓			
23	**P2BTPE211**	Laboratory course based on Human Disease Biology	2	6.5	13	Elective		50	✓	✓	✓	✓			
24	**P2BTPE212**	Laboratory course based on Proteomics and	2	6.5	13	Elective		50							

25	**P2BTTC301**	Bioprocess Technology	**4**	6.5	26	core	100		✓	✓	✓	✓				
26	**P2BTTC302**	Fundamentals of Genetics and Genomics	**4**	6.5	26	core	100		✓	✓	✓					
27	**P2BTTC303**	Basic Environmental Biotechnology	**4**	6.5	26	core	100		✓	✓	✓					
28	**P2BTTC304**	Fundamentals of Biostatistics and Bioinformatics	**2**	6.5	13	core	50		✓	✓	✓	✓				
29	**P2BTPC305**	Laboratory course based on Bioprocess Engineering	**2**	6.5	13	core		50	✓	✓	✓	✓				
30	**P2BTPC306**	Laboratory course based on fundamentals of Genetics and Genomics	**2**	6.5	13	core		50	✓	✓	✓	✓				
31	**P2BTPC307**	Laboratory course based on Fundamentals of Biostatistics and Bioinformatics	**2**	6.5	13	core		50	✓	✓	✓	✓				
32	**P2BTTE308**	Artificial Intelligence in Biology	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
33	**P2BTTE309**	Computational Genomics	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
34	**P2BTTE310**	Microbiomics	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
35	**P2BTPE311**	Laboratory course based on Artificail intelligence in Biology	**2**	6.5	13	Elective		50	✓	✓	✓	✓				
36	**P2BTPE312**	Laboratory course based on Computational Genomics	**2**	6.5	13	Elective		50	✓	✓	✓	✓				
37	**P2BTPE313**	Laboratory course based on Microbiomics	**2**	6.5	13	Elective		50	✓	✓	✓	✓				
38	**P2BTMO351**	**MOOCS course***	**4**	6.5	26	--	100		✓	✓	✓		✓			
39	**P2BTTC401**	Immunology and Immunotechnology	**4**	6.5	26	core	100		✓	✓	✓	✓				
40	**P2BTTC402**	Fundamentals of Plant Biotechnology	**2**	6.5	26	core	100		✓	✓	✓	✓				
	P2BTTC403	Applied Animal Biotechnology	**2**	6.5	13	core	50		✓	✓	✓	✓				
41	**P2BTPC405**	Laboratory course based on Immunology and Immunotechnology	**2**	6.5	13	core		50	✓	✓	✓	✓				
42	**P2BTPC406**	Laboratory course based on Fundamentals of Plant Biotechnology and Applied Animal Biotechnology	**2**	6.5	13	core		50	✓	✓	✓	✓				
43	**P2BTTE407**	Bioentrepreneurship	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
44	**P2BTTE408**	IPRs and Bioethics	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
45	**P2BTTE409**	Research Methodology and Scientific Communication	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
46	**P2BTTE410**	Functional Nutraceutical	**2**	6.5	13	Elective	50		✓	✓	✓	✓				
47	**P2BTRC411**	Research Project	**16**	6.5	204	core		400	✓	✓	✓	✓				✓

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER - 1

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: FUNDAMENTALS OF MOLECULAR BIOLOGY

Course code: P2BTTC101
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test 2: 1.0 hour
Major Test: 3 hours

Contact hours: 48
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objectives : In today's scientific world no biological study is complete till it is studied at the molecular level. This course will guide students about the basic background (physical and chemical) of molecular biology. The primary objective is to make students achieve a simple, comprehensive and interested view of basic composition of nucleic acids, their structure and their mode of replication. The study deals with conversion of genetic information coded in DNA to cellular macromolecules. The contents cover important aspects like, synthesis, modification and regulation of important cellular macromolecules, namely RNA and Protein.

Course Outcome :

CO 1: Understands the genomic organization of living organisms, study of genes genome, chromosome.
CO 2: Aware of molecular mechanism underlying in the process of prokaryotic DNA replication.
CO 3: Importance of gene expression (transcription & translation) and their regulations

UNIT-I: DNA STRUCTURE AND FUNCTION

i. Techniques to study nucleic acids; centrifugation, crystallography, electron-microscopy, spectroscopy and chromatography.
ii. DNA as a genetic material, DNA Structure and function: Physical and chemical structure of DNA, Alternate forms of DNA A, B, Z; Alternate DNA structure H-, G-; DNA loops; D-loop, R-loop, cruciforms, hairpin loops their biological significance & secondary structure.
iii. DNA structures; Primary, secondary, tertiary and quaternary DNA structure; Function of alternate forms and structures of DNA, Topography and superhelicity of DNA.
iv. Denaturation analysis of DNA; denaturation curve and assessment of GC% and Tm, hyper and hypochromic effect of DNA

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER - I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: FUNDAMENTALS OF MOLECULAR BIOLOGY

Course code: P2BTTC101 | **Contact hours: 48**

Duration of Examinations | **Max. Marks: 100**

Minor Test1: 1.0 hour | **Minor Test 1: 20**

Minor Test 2: 1.0 hour | **Minor Test 2: 20**

Major Test: 3 hours | **Major Test: 60**

Total: 100

UNIT-II: DNA REPLICATION AND INTRODUCTION TO RNA

i. Interaction of DNA with proteins; role of these interactions on the function of DNA, e.g. Zn finger, lucine zipper, helix turn helix and helix-loop -helix proteins

ii. Replication of DNA, Replication of extrachromosomal DNA, Elements and factors required for replication of core genome in eukaryotes, prokaryotes

iii. Replication of core gene, chromosomal replication with chromosomal replication in *E. coli* and *S. cerevisae*, as reference.

iv. Extra chromosomal elements replication with phi X174, Plasmid and mitochondrial replication as reference

UNIT-III: GENE EXPRESSION I - TRANSCRIPTION

i. RNA structure and function. RNA as a structural molecule: transfer and ribosomal RNA, RNA as information molecule: messenger RNA, small RNA, non-coding RNA

ii. Mechanism of transcription in prokaryotes; Elements and factors involved in transcription; Promoter sequences and other regulatory factors, Inhibitors of replication and transcription.

iii. Operon concept; Inducible and repressible operons in prokaryotes. Attenuation, anti-termination, auto-regulation of gene expression. Negative and positive control of gene expression.

iv. Mechanism of transcription in eukaryotes: Gene activation in eukaryotes, Basal transcription apparatus, Eukaryotic promoter, enhancers, silencers, sequences, General and specific factors. Initiation, elongation and termination of transcription in Eukaryotes.

UNIT-IV: GENE EXPRESSION II- TRANSCRIPTION/TRANSLATION

i. Post transcriptional regulation: mRNA processing capping and polyadenylation. mRNA splicing and editing, nucleo-cytoplasmic mRNA transport, mRNA stability, degradation and half life period. Differential gene expression

ii. Genetic Code: Universality and degeneracy of code and exceptions to code, Wobble hypothesis, Codon usage bias.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER - I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: FUNDAMENTALS OF MOLECULAR BIOLOGY

Course code: P2BTTC101 | **Contact hours: 48**

Duration of Examinations | **Max. Marks: 100**

Minor Test1: 1.0 hour | **Minor Test 1: 20**

Minor Test 2: 1.0 hour | **Minor Test 2: 20**

Major Test: 3 hours | **Major Test: 60**

Total: 100

iii. Mechanism of translation in prokaryotes: Elements and factors required for translation, Co-transcriptional- translation regulation of prokaryotic translation.

iv. Initiation, elongation and termination of translation in prokaryotes. Non- ribosomal peptide synthesis.

UNIT V: GENE EXPRESSION III- TRANSLATION AND DNA DAMAGE AND REPAIR.

i. Mechanism of translation/ Protein biosynthesis in eukaryotes: Elements and factors required for translation, Initiation, elongation and termination of translation in eukaryotes Codon-Anticodon recognition, Recycling of ribosome, Posttranslational modifications, Inhibitors of protein synthesis

ii. Regulation of eukaryotic translation, Non ribosomal translation and its importance

iii. DNA Damage: radiation damage, alkylation damage, mutagen and carcinogen damage, oxidative damage and instability in water

iv. DNA repair: direct reversal of damage, base excision repair, nucleotide excision repair, mismatch repair and SOS repair

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test	100%	3 hours	60

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER - I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: FUNDAMENTALS OF MOLECULAR BIOLOGY

Course code: P2BTTC101 | **Contact hours: 48**

Duration of Examinations | **Max. Marks: 100**

Minor Test1: 1.0 hour | **Minor Test 1: 20**

Minor Test 2: 1.0 hour | **Minor Test 2: 20**

Major Test: 3 hours | **Major Test: 60**

Total: 100

(after 90 days)			
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) ex amination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER - 1

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: FUNDAMENTALS OF MOLECULAR BIOLOGY

Course code: P2BTTC101	**Contact hours: 48**
Duration of Examinations	**Max. Marks: 100**
Minor Test1: 1.0 hour	**Minor Test 1: 20**
Minor Test 2: 1.0 hour	**Minor Test 2: 20**
Major Test: 3 hours	**Major Test: 60**
	Total: 100

teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. Krebs JE, Goldstein ES, Kilpatrick S (2020) Lewin's Essential genes-4th edition, Jones and Bartlett Publishers, Inc.
2. Karp's (2019) Cell and Molecular Biology- 9th Edition | Wiley.
3. Nelson and Cox (2021) Lehninger Principles of Biochemistry- 8th Edition, Macmillan learning
4. Watson J.D (2017). Molecular biology of the gene- 7th Edition, Pearson Education.
5. Krebs J.E, Goldstein E.S, Kilpatrick S.T (2018). Lewin's Genes XII. Jones & Bartlett Learning
6. Russell (2016). Genetics: A molecular approach. Pearson Education.
7. Bruce Alberts (2014) Molecular Biology of the Cell- 6th Edition, Garland Science
8. Burton E (2012). Molecular Biology: genes to proteins - 4th Edition, Jones & Bartlett Publishers.
9. Krebs J, Goldstein E, Kilpatrick S (2011) Lewin's Genes X -10th Edition, Jones & Bartlett Publishers
10. Hartwell L (2010). Genetics from genes to genomes- 4th Edition. Macgraw-hill Education.
11. Clark &Pazdernik (2009). Biotechnology: applying the genetic revolution. Academic Press
12. Lodish, Harvey F (2000) Molecular cell biology, New York : W.H. Freeman

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: CELLULAR BIOLOGY
Course code: P2BTTC102
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objective:
The course will equip students with foundational and applied knowledge essential for research and advanced studies in cell biology. It will also build analytical skills crucial for understanding cellular mechanisms and applying them in life sciences research

Course Outcome:

Upon completion of the course students will know

CO1: Introduction about the origins of cells, diversity, structure and function of cell organelles

CO2: Acquainted with various sophisticated instruments and their implementation in biological research

CO3: Concept of cell signalling, communication, cell growth, division, cell cycle and its regulations

CO4: Brief idea of cellular basis of differentiation and development.

UNIT I: CELL STRUCTURE AND ORGANIZATION

i. Cell Theory & Cell Types: Cell theory, prokaryotic and eukaryotic cells, diversity in size and shape, unicellular vs. multicellular, cellular compartments.
ii. Biomembranes: Fluid mosaic model, lipid bilayer, integral/peripheral proteins, membrane transport, membrane asymmetry.
iii. Cellular Organelles: Structure of nucleus, ER, Golgi, mitochondria, chloroplasts, lysosomes, peroxisomes.
iv. Cytoskeleton and Motility: Microtubules, microfilaments, intermediate filaments, motor proteins, cilia & flagella.

UNIT II: MEMBRANE DYNAMICS AND INTRACELLULAR TRAFFICKING

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: CELLULAR BIOLOGY

Course code: P2BTTC102
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

i. Transport Mechanisms: Passive and active transport, ion channels, Na /K ATPase, ABC transporters, co-transporters.
ii. Endocytosis & Exocytosis: Clathrin-mediated uptake, caveolae, vesicle formation, exocytic pathways, recycling endosomes.
iii. Vesicular Trafficking: ER-Golgi transport, vesicle budding/fusion, SNAREs, Rab proteins, lysosomal targeting.
iv. Nuclear Transport & Chromatin: Nuclear pore complex, import/export signals, chromatin structure, histones, chromatin remodeling.

UNIT III: CELL SIGNALING AND COMMUNICATION

i. Signal Transduction Pathways: Hormones and receptors, GPCRs, second messengers, Ras/MAPK, RTKs.
ii. Microbial & Plant Signaling: Quorum sensing, bacterial chemotaxis, two-component systems, Ca^{2} signaling, phytochromes.
iii. Cell-Cell Communication: ECM, integrins, cell adhesion molecules, junctional complexes, general signaling principles.
iv. Neuronal Signaling: Neurotransmission, synapse structure, neurotransmitter types, receptor regulation.

UNIT IV: CELL CYCLE, GROWTH, AND DEATH

i. Cell Cycle Control: Phases, cyclins/CDKs, checkpoints, DNA replication licensing, mitotic exit.
ii. Mitosis & Meiosis: Stages, spindle formation, chromosome alignment/separation, synapsis, recombination.
iii. Cell Death Mechanisms: Apoptosis pathways, caspases, autophagy, necrosis, survival signaling.
iv. Cancer Cell Biology: Oncogenes, tumor suppressors, cell cycle defects, EMT & metastasis, cancer models

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: CELLULAR BIOLOGY

Course code: P2BTTC102
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

UNIT V: DEVELOPMENT BIOLOGY AND CELLULAR AGING

i. Gametogenesis & Early Development: Gamete formation, fertilization mechanisms, cleavage patterns, gastrulation, embryonic layers.
ii. Plant Developmental Biology: Shoot/root apical meristem, leaf development, floral development, seed germination.
iii. Animal Model Systems: Drosophila segmentation, C. elegans development, homeotic genes, organogenesis.
iv. Aging and Senescence: Telomere shortening, mitochondrial dysfunction, Cellular Senescence Mechanisms.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External	100%	2 hours	25

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: CELLULAR BIOLOGY

Course code: P2BTTC102
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Examination			
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: CELLULAR BIOLOGY

Course code: P2BTTC102
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

BOOKS RECOMMENDED:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. *Molecular Biology of the Cell* (6th Edition) – Garland Science, 2014.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., & Matsudaira, P. *Molecular Cell Biology* (8th Edition) – W.H. Freeman and Company, 2016.
3. Karp, G. *Cell and Molecular Biology: Concepts and Experiments* (8th Edition) – Wiley, 2018.
4. Cooper, G. M., & Hausman, R. E. *The Cell: A Molecular Approach* (7th Edition) – Oxford University Press, 2018.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: BASICS OF BIOCHEMISTRY AND METABOLISM

Course code: P2BTTC103
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objective : The basic goal of this course is to determine how the collections of inanimate molecules that constitute living organisms, interact with each other to maintain and perpetuate the living state. Biochemistry yields important insights and practical application in medicine, agriculture, nutrition and industry, but its ultimate concern is with the wonder of life and living things.

Course Outcome :

CO1: The Course aims to make students familiar with the basics of Biochemistry and determine how the collections of inanimate molecules that constitute living organisms, interact with each other to maintain and perpetuate the living state.

CO2: Students get to know about various biochemical processes with a special emphasis on various biomolecules like carbohydrates, Proteins, Lipids and Nucleic acids.

CO3: The students get an overview of various metabolic pathways and cycles involved in cellular metabolism and how an imbalance or anomaly in functioning of these pathways can prove to be of clinical significance.

CO4: The course aims at priming the students towards understanding deeper concepts of cellular functioning in living systems.

UNIT-I: CARBOHYDRATE METABOLISM

i. Occurrence, classification, structure of disacharrides and polysacharrides, properties and biological importance of carbohydrates, Stereochemistry of carbohydrates
ii. Metabolic pathways; glycolysis, acrobic and anaerobic glycolysis, oxidation of Pyruvate to Acetyl Co A
iii. Citric acid cycle and its regulation; Glyoxylate cycle; Gluconeogenesis.
iv. The pentose-phosphate reductive pathway, uronic acid pathway and their significance

UNIT-II: PROTEIN CHEMISTRY AND METABOLISM

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

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Major Test: 60
Total: 100

i. Proteins: Structure, classification and functions. Structure and classification of amino acids
ii. Titration curves; Metabolism of simple, branched and aromatic amino acids; Biosynthesis of essential amino acid.
iii. Degradation of different amino acids to TCA Cycle intermediates; glucogenic and ketogenic amino acids metabolism; Allosteric regulation of amino acid biosynthesis.
iv. Urea cycle; Inborn errors of amino acid metabolism, Aminoaciduria.

UNIT-III: PHOTOSYNTHESIS AND ATP SYNTHESIS

i. Photosynthesis: concept and significance, Z scheme of photophosphorylation; C3 and C4 pathways, their nature and regulation.
ii. ATP cycle; bioenergetics; concept of entropy; free energy.
iii. Electron transport chain, substrate- level and oxidative phosphorylaton.
iv. Chemiosmotic theory for ATP synthesis, regulation of ATP production; Glycerol 3 P shuttle and Malate Aspartate shuttle system.

UNIT-IV : LIPID CHEMISTRY AND METABOLISM

i. Fatty acids as building blocks of most lipids, major classes of lipids and their role.

ii. Biosynthesis of even-Chain, odd-Chain, saturated and unsaturated- fatty acids.
iii. Biosynthesis of fats, phospholipids, glycolipids and sphingolipids, prostaglandins and cholesterol.
iv. Oxidation of fatty acids, α- β- and ω oxidation; Ketogenesis and its regulation.

UNIT-V: NUCLEIC ACID CHEMISTRY AND METABOLISM

i. Nucleic acid chemistry and structure of DNA and various RNAs.
ii. Metabolism of purine- and pyrimidine- nucleotides; biosynthesis of pyrimidine nucleotides; their regulation, catabolism of pyrimidines.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology
SEMESTER I

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Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

iii. Purine salvage pathway, Pathway of de novo purine biosynthesis from ribosephosphate and ATP, their regulation, catabolism of purines.
iv. Regulation of biosynthesis by feedback control; Genetic disorders and hyperuricemia.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

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Credits: 4
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Major Test: 60
Total: 100

External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

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Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

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Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

BOOKS RECOMMENDED :

1. Berg JM, Tymoczko, JL and Stryer L, Gregory Gatto (2019) Biochemistry, 9th Edition, WH Freeman & Co., New York.
2. Cohn EE, Stumph PK, Bruening G and Doi RH (1987) Outlines of Biochemistry, 5th Edition, John Wiley & Sons, New York.
3. Victor W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil (2018). Harper's Illustrated Biochemistry, 31st Eidtion, Applaton and Lange Publications, California, USA.
4. Nelson DL and Cox MM. (2021) Lehninger Principles of Biochemistry, 8th Edition. Macmillan Worth Publishers, New Delhi.
5. Voet D, Voet JG and Pratt CW (2016). Fundamentals of Biochemistry, 5th Edition. John Wiley & Sons. New York.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: MOLECULAR VIROLOGY AND VACCINOLOGY

Course code: P2BTTE107	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.0 hour	**Max. Marks: 100**
Minor Test2: 1.0 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

Course Objective: Upon completing this course, students will be able to describe the fundamental properties and classification of viruses, explain the mechanisms of viral infection and replication, identify and describe various types of viruses, discuss the pathogenesis and immune response to viral infections, apply knowledge of virology to understand viral diseases and control measures, analyze and interpret data related to viral infections and diseases, and evaluate the role of viruses in human, animal, and plant diseases, ultimately developing skills in viral detection, genome analysis, vaccine development, and critical thinking.

Course Outcome:
In the end of the course, the student should be able to:-

CO1: Outline the process of viral infection and multiplication

CO2: Discuss virus-host interactions and host response to viral infections

CO3: Discuss different types of DNA and RNA viruses infecting animals and human.

CO4: Discuss different aspects of virus control including conventional as well as modern approaches.

CO5: Discuss various type of vaccine and their mode of action

UNIT-I: VIRUS-HOST INTERACTION

i. Overview of Virus: structure, capsid, envelop and classification; viral pathogenesis mechanism: viral adhesion and entry.
ii. Viral multiplication, viral gene expression and regulation: Cap snatching, IRES, ribosomal frameshifting, Inhibition of host translation, intracellular trafficking, viral assembly, and release. Case study: Covid-19, HIV.
iii. Host response to viral infection: Innate Immunity and Viral Recognition: Toll-like receptors, RIG-I-like receptors, Type 1 interferons, NK cells. Adaptive Immunity to Viruses: B cells and neutralizing antibodies, CD8+ cytotoxic T cells, CD4+ helper T cells, Memory responses.
iv. Evasion of Immune Responses by Viruses: Inhibition of interferon signalling, Downregulation of MHC molecules, Latency and antigenic variation, Cytokine storms, Viral triggers of autoimmunity.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Minor Test 2: 20
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Total: 100

UNIT II: TYPES OF VIRUSES-II

i. Animal viruses: dsDNA viruses (Adenoviruses, Herpes virus, Pox virus, Arbovirus); ssDNA viruses: Parvovirus- M13, AAV).
ii. dsRNA viruses: Rotavirus, Reovirus; ss (-) sense RNA viruses: Orthomyxovirus and Paramyxovirus (Influenza and Measles).
iii. ss (+) RNA viruses: Poliovirus, SARS-CoV-2, Hepatitis virus.
iv. Retroviruses: ssRNA- HIV and dsDNA viruses with reverse transcriptase activity- Hepatitis B; and Oncogenic viruses- HPV.

UNIT - III: TYPES OF VIRUSES -II

i. Bacteriophage structural organization, Life cycle; lysogenic and lytic. Case study Bacteriophage T4 for lytic and Lambda for Lysogeny
ii. Brief details on M13, Mu, T-even, T-odd and P1. Bacteriophage typing and its application in bacterial genetics.
iii. Plant viruses: TMV, Cauliflower mosaic virus, Potato mosaic virus.
iv. Viruses of Cyanobacteria, algae and fungi, Virus related agents; viroids and prions

UNIT-IV: INTRODUCTION TO VACCINES AND ANTIVIRALS

i. History and evolution of vaccines, public health importance, Types of vaccines (live attenuated, inactivated, subunit, conjugate, mRNA, DNA, vector-based), Personalized and pan-pathogen vaccines.
ii. Antivirals: designing and screening for antivirals, mechanisms of action; Antiretrovirals mechanism of action and drug resistance.
iii. Diagnostics and detection of viral diseases: Serological tests and Molecular techniques
iv. Modern approaches of virus control: Anti-sense RNA, siRNA, ribozymes.

UNIT V: VACCINE MANUFACTURING AND QUALITY CONTROL

i. Pre-clinical stages; Antigen selection and purification; formulation development and delivery system; Dosage determination; immunogenicity in animal models
ii. Regulatory Review and Approval; Evaluation of safety immunogenicity, and efficacy, stability testing; ethics and regulations.

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M.Sc. Biotechnology

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Total: 100

iii. Clinical development stages: upstream and downstream process; Clinical trial design: Phases I-IV; Production technologies (e.g., cell culture, bioreactors), Good manufacturing practices (GMP).
iv. Distribution and Vaccination Program; Strategies for vaccine delivery (routine, mass campaigns), Global vaccine initiatives (e.g., GAVI, WHO programs), Vaccine coverage and herd immunity.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

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Contact hours: 48
Credits: 4
Max. Marks: 100
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Minor Test 2: 20
Major Test: 60
Total: 100

Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
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M.Sc. Biotechnology

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BOOKS RECOMMENDED

1. Adoga M.P (2017). Molecular Virology. 7th edition. Publisher: Intech
2. Alan J. Cann (2000) DNA virus Replication. Publisher: Oxford University Press.
3. Alan J. Cann (2005) Principles of Molecular Virology. Publisher: Elsevier Science and Technology Books.
4. Bhat, A. I., & Rao, G. P. (2020). Characterization of plant viruses: Methods and protocols. Springer.
5. Carter J., Saunders V. (2013). Virology: Principles and Applications. 2nd edition, Wiley.
6. Dimmock, N., Easton, A., & Leppard, K. (2016). Introduction to modern virology (6th ed.). Wiley-Blackwell.
7. Flint S.J., Racaniello V.R., Enquist L.W., Rancaniello V.R., Skalka A.M. (2020) Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. 5th Edition. Publisher: American Society Microbiology.
8. Gaur, R. K., Khurana, S. M. P., & Dorokhov, Y. (2020). Plant viruses: Diversity, interaction and management. CRC Press.
9. Howley, P. M., & Knipe, D. M. (2020). Fields virology: Emerging viruses (7th ed.). Wolters Kluwer.
10. Lostroh, P. (2019). Molecular and cellular biology of viruses. Garland Science.
11. Riedel S, Hobden JA, Miller S, Morse S A., Mietzner T A., Detrick B, Mitchell T G., Sakanari J A., Hotez P, Mejia R (2019) Medical Microbiology. McGraw-Hill Education. 28th edition
12. Stephen K. Tyring. (2004) Field Virology Vol.1 and 2. Antiviral Agents, Vaccines, and Immunotherapies. Publisher: Marcel Dekker.

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M.Sc. Biotechnology

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13. Wagner, E. K., Hewlett, M. J., Bloom, D. C., & Camerini, D. (2017). Basic virology (3rd ed.). Wiley-Blackwell.
14. Vaccinology: Principles and Practice. (2012). Germany: Wiley. ISBN: 9781118345344, 11.18345347
15. System Vaccinology: The History, the Translational Challenges and the Future. (2022). Netherlands: Elsevier Science. ISBN: 9780323897860, 032389786X

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: ANALYTICAL TECHNIQUES IN BIOLOGY

Course code: P2BTTE108
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

COURSE OBJECTIVES: This course provides a comprehensive understanding of the fundamental and advanced principles, along with the applications of various analytical techniques crucial for modern biological and biomedical research. It systematically covers methodologies ranging from basic microscopy to cutting-edge sophisticated analytical and imaging tools. Emphasis will be placed on the theoretical underpinnings, practical applications, and recent advancements in these dynamic fields.

Course Outcome:

CO1:Understand the principle, working and applications of analytical

techniques available for studying biochemical and biophysical nature of life.

CO2:Understand the various microscopy techniques and principles of electrochemical techniques.

CO3: Understand various spectroscopic techniques including UV, Visible and NMR.

CO4: Understand various separation techniques.

CO5: Understanding of purification techniques and radioisotopic methods of analysis.

UNIT-1: MICROSCOPY AND ELECTROCHEMICAL TECHNIQUES

i. Introduction to Analytical Techniques - Classification: Qualitative vs Quantitative technique. homogenization techniques
ii. Organ and tissue slice technique, histopathology analysis including Immunohistochemistry, Immunocytochemistry
iii. Basic principles, instrumentation and applications of microscopy: Bright field, Phase-contrast, Fluorescence and Confocal Microscopy, Electron Microscope – SEM, TEM, Atomic Force Microscopy.
iv. Principles of electrochemical techniques – measurement of pH by glass electrode and hydrogen electrode. Oxygen electrode – principles, and its applications.

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M.Sc. Biotechnology

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UNIT 2: SPECTROSCOPIC TECHNIQUES

i. Introduction to spectroscopy: Concept of absorptions, transmission, scattering, phosphorescence, fluorescence spectra.
ii. Principle, instrumentation, working and application of UV - Visible spectroscopy, spectrofluorimetry, flame photometry, atomic absorption spectrometry.
iii. Principle and application of Nuclear Magnetic Resonance (NMR) and X-ray Crystallography
iv. Mass spectrometry: Matrix-assisted laser desorption/ionization, Time- of Flight Mass spectroscopy (MALDI-TOF MS). Principles and applications of Surface Plasmon Resonance (SPR)

UNIT 3: SEPARATION TECHNIQUES

i. Electrophoresis: Basic principles and Factors affecting electrophoresis. Agarose gel SDS-PAGE, Capillary and Pulsed field – instrumentation and application
ii. Isoelectric focusing: principle, ampholyte, development of pH gradient and application. 2D electrophoresis.
iii. Electro-transfer techniques: Principle, methodology and applications of Western, Southern and Northern blotting
iv. Sedimentation Techniques: Basic principles of Centrifugation, Differential centrifugation, Density gradient centrifugation.

UNIT 4: PURIFICATION TECHNIQUES

i. Principles- adsorption and partition, Planar chromatography vs Column chromatography, Phases: Stationary vs Mobile, Retention factor (Rf).
ii. Paper chromatography, TLC, HPTLC, Ion-exchange chromatography, Gel-filtration chromatography and Affinity chromatography
iii. Gas liquid chromatography- principle, instrumentation, detectors and applications. GC-MS, LC-MS/MS

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M.Sc. Biotechnology

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Major Test: 60
Total: 100

iv. High pressure liquid chromatography- principle, instrumentation and application. Reverse HPLC

UNIT 5: RADIO ISOTOPIC METHODS OF ANALYSIS:

i. Introduction to Radioisotopes: Isotopes, radioisotopes, radionuclides, Types of radiation, Half-life, decay constant, specific activity, units of radioactivity.
ii. Production and Properties of Radioisotopes: Natural vs. artificial radioisotopes, Cyclotrons, nuclear reactors, and isotope generators, Radiolabeling strategies for biomolecules.
iii. Detection and Measurement of Radioactivity: Geiger-Müller counter, Scintillation counters, Gamma counters, Autoradiography.
iv. Applications of Radioisotopes in Biology: Tracer Techniques - Metabolic pathway studies. Nutrient uptake and distribution, Radiolabeled Probes - DNA/RNA hybridization (Southern/Northern blot), hormone assays, Non- Radiolabeled Probes and FACS

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
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TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be	Time allotted for	%Weightage

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: ANALYTICAL TECHNIQUES IN BIOLOGY

Course code: P2BTTE108
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

	covered in the examination	the examination	(Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

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Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. Keith Wilson, John Walker (2018) Principles and Techniques of Biochemistry and Molecular Biology (8th ed) Cambridge University Press
2. Holme, David J., and Hazel Peck. (1998). *Analytical Biochemistry*. (3rd ed.) Harlow: Pearson Education
3. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
4. David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology,W.H.Freeman
5. Rodney F.Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques, (2nd ed), Prentice Hall
6. Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer
7. Segel I.H (1976) Biochemical Calculations (2nd ed), John Wiley and Sons

M.Sc. Biotechnology

SEMESTER I

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Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

8. Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

Syllabi for the examinations to be held in the years Dec 2025, DEC 2026 & Dec 2027

COURSE TITLE: MICRONUTRIENTS AND MAMMALIAN HORMONES

Course code: P2BTTE109
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objectives: The course provides knowledge of Vitamins and Hormones.

Course Outcome:

After successful completion of course, the students will be able to understand:

CO1. Importance of fat- soluble vitamins in growth and development, their recommended dietary allowance, dietary source and deficiency diseases.

CO2. Importance of water-soluble vitamins in growth and development, their recommended dietary allowance, dietary source and deficiency diseases

CO3. Various Hormones released by endocrine glands their importance and disorders due to imbalance.

UNIT 1: FAT SOLUBLE VITAMINS

i. Vitamins: Definition, pro-vitamins, Vitamins as Coenzymes.
ii. Structure, Biochemical and Physiological roles, Sources, Recommended daily dosages and deficiency symptoms of Vitamin A.
iii. Structure, Biochemical and Physiological roles, Sources, Recommended daily dosages and deficiency symptoms of Vitamin D.
iv. Structure, Biochemical and Physiological roles, Sources, Recommended daily dosages and deficiency symptoms of Vitamin E and K. Porphyrins: the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

UNIT 2: WATER SOLUBLE VITAMINS

i. Structure, Biochemical and Physiological roles, Sources, Recommended daily dosages and deficiency symptoms of Thiamine (TPP), Riboflavin (FMN&FAD).
ii. Structure, Biochemical and Physiological roles, Sources, Recommended daily dosages and deficiency symptoms of Niacin, Pantothenic acid.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER I

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Duration of Examinations	**Credits: 4**
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Minor Test2: 1.0 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

iii. Structure, Biochemical and Physiological roles, Sources, Recommended daily dosages and deficiency symptoms of Pyridoxine, Biotin,

iv. Structure, Biochemical and Physiological roles, Sources, recommended daily dosages and deficiency symptoms of Folic acid, Vitamin B12, Recommended Dietary Allowance, dietary source and deficiency, vitamins like compounds; PABA, bioflavonoids, antivitamins.

UNIT 3: MINERALS AND THEIR ROLE IN BODY

i. Macro and Micro nutrients including trace elements. Minerals: their source, functions and deficiency symptoms.

ii. Role of Calcium and Phosphate in bone and dentine formation, role of Iodine in thyroid.

iii. Role of Iron in Heme synthesis, role of Magnesium.

iv. Role of Zinc and Copper. Metal activated enzymes and metalloenzymes, activation of alkali metal cations, alkaline earth metals and transition metal cations.

UNIT 4: VERTEBRATE HORMONES-I

i. Introduction, classification, mechanism of action of steroid hormones.

ii. Hypothalamic Hormones; TRH, CRH and GnRH,

iii. Anterior and Posterior pituitary hormones

iv. Growth Hormone, Glycoprotein hormones, oxytocin- their functions and disorders due to imbalance.

UNIT 5: VERTEBRATE HORMONES-II

i. Thyroid hormone, Hormones of adrenal cortex,

ii. Hormones of Gonads; androgens, estrogens and Progesterone - their functions and disorders due to imbalance.

iii. Insulin, Insulin-mediated glucose transport, regulation of blood glucose, sources of blood glucose.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Minor Test2: 1.0 hour | **Minor Test 1: 20**

Major Test: 3.0 hours | **Minor Test 2: 20**

Major Test: 60

Total: 100

iv. Diabetes Mellitus; classification, glucose tolerance test, comparison of two types of diabetes mellitus, glycosuria, metabolic changes in diabetes, management.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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M.Sc. Biotechnology

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External Practical/ Research (thesis/project/patent) examination

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Books Recommended:

1. Voet D, Voet JG and Pratt CW (2016). Fundamentals of Biochemistry, 5th Edition. John Wiley & Sons. New York.
2. Nelson DL and Cox MM. (2021) Lehninger Principles of Biochemistry, 8th Edition. Macmillan Worth Publishers, New Delhi.
3. Guyton, A. C. (2015). Text Book of Medical Physiology, 13th ed. W. B. Saunders Co., USA 978-1455770168
4. Gangong F. William: Review of Medical Physiology 20th Edition.
5. Gaw, A., Cowan, R.A., O'Reilly, D.S.J., Stewart, M.J., Shepherd, J. 5th Edition (2013) Clinical Biochemistry, Churchill Livingstone, Edinburgh London.
6. Smith, A.F., Beckett, G.J., Walker, S.W. and Rae, P.W.H. (2013): Clinical Biochemistry. 8th Edition, Blackwell Science.
7. Voet D, Voet JG and Pratt CW (2016). Fundamentals of Biochemistry, 5th Edition. John Wiley & Sons. New York.
8. Nelson DL and Cox MM. (2021) Lehninger Principles of Biochemistry, 8th Edition. Macmillan Worth Publishers, New Delhi.
9. Guyton, A. C. (2015). Text Book of Medical Physiology, 13th ed. W. B. Saunders Co., USA 978-1455770168
10. Gangong F. William: Review of Medical Physiology 20th Edition.
11. Gaw, A., Cowan, R.A., O'Reilly, D.S.J., Stewart, M.J., Shepherd, J. 5th Edition (2013) Clinical Biochemistry, Churchill Livingstone, Edinburgh London.
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Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology
SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May. 2028

COURSE TITLE: RECOMBINAT DNA TECHNOLOGY

Course code: P2BTTC201
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course objective: The aim of the course is to extend the student's understanding of new concepts and expertise in molecular biology and fundamentals of recombinant DNA technology.

Course outcome:
Upon the completion of the course students will have knowledge about

CO1: Genetic engineering and its benefits, Basic principles, the tools and techniques of cloning and gene sequencing.

CO2: Various vectors for transformation, Advantages and limitations of expression vectors, model organism for gene cloning.

CO3: Skills of applying genetic engineering technologies in various fields of Biotechnology.

UNIT-I: TOOLS AND TECHNIQUES USED IN GENETIC ENGINEERING

i. Principles and mechanism of isolation, purification, quantification and electrophoresis of nuclear and cytoplasmic, Molecular tools and their uses DNA and RNA
ii. Size standards for DNA and RNA, Principles and mechanism of isolation, purification, quantification and electrophoresis of environmental DNA and RNA
iii. Enzymes used in genetic engineering: restriction endonucleases, Ligases, Kinases, Phosphatases, Polymerases, terminal transferases
iv. Gene cloning vectors: plasmids, bacteriophages, cosmids and artificial chromosomes

UNIT-II: GENE/s CLONING TECHNIQUES

i. Construction of genomic library. Preparation of vector and insert for cloning and construction of recombinant DNA molecule. Transformation of *E.coli* with recombinant DNA.
ii. Construction of DNA library, RNA enrichment techniques. Cloning differentially active genes.
iii. NAAT, Isothermal amplification & thermal amplification, primer design and programming. modifications of basic PCR.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology
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Major Test: 60
Total: 100

iv. Southern, Northern and Western blotting; Preparation of labeled DNA probes-radioactive and non- radioactive labeling.

UNIT-III: GENE/S EXPRESSION TECHNIQUES

i. Gene centric cloning and genome centric cloning, Isolation, identification and characterization of gene.
ii. Screening and analysis of genomic and cDNA library by function and sequence based methods.
iii. Identification of interacting genes; two and three hybrid system, RNase protection assay and reporter assay, Phage display.
iv. Expression strategies for heterologous genes; vector engineering and codon optimization, host engineering, Expression in eukaryotic and prokaryotic systems; In vitro transcription and translation, methods and application.

UNIT-IV: ADVANCED TECHNIQUES IN GENETIC ENGINEERING

i. DNA sequencing Sanger's Chain termination methods, next generation sequencing (NGS), Short read sequencing: Illumina. Ion Torrent, Long read sequencing: Single Molecule Real-Time (SMRT), HiFi sequencing, Oxford Nanopore
ii. Targeted sequencing and whole genome sequencing methods using NGS
iii. Genome engineering: Genome/gene editing methods, strategies and applications
iv. Introduction to synthetic biology; chemical synthesis of nucleic acids, methods, strategies and applications, Gene circuits.

UNIT-V: APPLICATION OF GENETIC ENGINEERING

i. Gene knockout: Site directed mutagenesis Protein engineering Directed protein evolution
ii. Genetic engineering in molecular diagnostics, Nucleic based diagnostics and protein based diagnostics
iii. Production of genetically engineered drugs and vaccines, industrial products of genetically modified organisms

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology
SEMESTER II

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Contact hours: 48
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Minor Test 2: 20
Major Test: 60
Total: 100

iv. Artificial intelligence and Machine learning in recombinant DNA technology and its application.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
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Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
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The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology
SEMESTER II

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Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. Brown, T.A (2020) Gene Cloning and DNA Analysis: An Introduction. Wiley-
2. Blackwell Publishing, UK.
3. Glick B. R and Patten C. L. (2017) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, USA.
4. Green M. R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual. CSHL Press, USA.
5. Primrose, S. B. and Twyman, R. M. (2006) Principles of Genetic Manipulation and Genomics. Blackwell Publishing, UK.

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M.Sc. Biotechnology
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Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: ENZYMES AND ENZYME TECHNOLOGY

Course code: P2BTTC202
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course objective: The course is structured to provide the students insight into protein/ enzyme structure, enzyme kinetics and mechanism & control of enzyme action, enzyme folding, enzyme purification and enzymes characterization. It also aims at acquainting students with clinical and industrial applications of enzymes.

Course Outcome:

After completion of the course the students are:

CO1: Able to understand structure, function and mechanism of action of enzymes in living systems

CO2: Able to acquire knowledge on enzyme classes and nomenclature, kinetics, role of enzymes in regulation and metabolism

CO3: Able to apply the knowledge for developing application based technological processes in a variety of areas such as food, feed, pharmaceutical, textile, leather, and others.

NIT-I: INTRODUCTION TO ENZYMES

i. General characteristics of enzymes, nature of enzymatic and non-enzymatic catalysis, Enzyme specificity, biocatalysts vs chemical catalysts
ii. Criteria for Nomenclature and IUB classification of enzymes, significance of nomenclature and classification of enzymes; significance of numbering system,
iii. Holoenzyme, apoenzyme cofactor, coenzyme, prosthetic group, Basis of enzyme assays, Units of enzyme activity- IU, katal, turn over number and specific activity;
iv. Structure of enzyme proteins, N and C terminal amino acid determination, sequencing of polypeptides, protein folding, amino acid side chains and their influence on preferred folding; other catalytic bio-molecules.

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M.Sc. Biotechnology

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UNIT-II: MECHANISM OF ENZYME ACTION

i. Enzyme catalysis; effect of enzyme on the rate and equilibrium of a reaction; Specificity of enzyme action: type of specificity, lock and key, induced fit hypothesis,

ii. Chemical mechanisms involved in biocatalysis, proximity and orientation effect, acid/base catalysis covalent catalysis, strain and distortion theory;

iii. Active (catalytic) site, elucidation of amino acids involved in active site, identification of functional groups at active sites;

iv. Mechanism of action of chymotrypsin, carboxypeptidase, ribonuclease and lysozyme;

UNIT-III: KINETICS OF ENZYME CATALYSED REACTIONS

i. Principles of bioenergetics, basis of kinetics of enzyme catalysed reactions

ii. Steady state vs equilibrium assumption, Henri and Michaelis-Menten equations, Michaelis-Menten equation for uni-substrate enzyme catalysed reactions and its significance,

iii. Kinetic parameters V_{max}, K_m , Lineweaver-Burk plots, Eadie-Hofstee and Hanes plots, factors affecting enzyme activity: enzyme/substrate concentration, pH and temperature dependence of enzymes,

iv. Enzyme inhibitions: Reversible and irreversible inhibition, types of enzyme inhibitions, and determination of K_i.

UNIT-IV: REGULATORY ENZYMES

Enzymes in regulation of metabolic pathways

ii. , covalent and noncovalent modification of enzymes, Allosteric enzymes, sigmoidal kinetics and its physiological significance.

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ii. General mechanisms of enzyme regulation: Feedback inhibition, Feedback repression, induction.

iii. Partial Proteolysis; Covalent modification of enzymes-reversible covalent modification.

iv. Phosphorylation, adenylylation, uridylation, ADP-ribosylation, methylation, disulphide reduction as means of regulation.

UNIT-V: ENZYME TECHNOLOGY

i. Strategies for bulk enzyme production, sources of enzyme isolation, Enzyme purification.

ii. Criteria and aim for purification, techniques /steps involved, Chromatography, ion exchange, adsorption, hydrophobic, and gel filteration; salting out.

iii. Ascertaining purity level of enzyme, specific activity; criteria of enzyme purity, characterization of an enzyme, determination of the molecular weight (Mr).

iv. Industrial applications of enzymes- in diagnosis, therapy, brewery, dairy, food processing, detergent, textile; enzyme immobilization and its industrial importance; protein engineering, enzyme inhibitors and drug design.

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Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Major Test: 60
Total: 100

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED:

1. Keshavamurthy, M., Avinash, K. O., & Kiran, K. S. (2024). Advances in enzymology. P.K. Publishers & Distributors.
2. Likhtenshtein, G. I. (2024). Enzyme catalysis today and the chemistry of the 21st century. Springer Cham.
3. Copeland, R. A. (2023). Enzymes: A practical introduction to structure, mechanism, and data analysis (3rd ed.). Wiley.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: ENZYMES AND ENZYME TECHNOLOGY

Course code: P2BTTC202
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

4. Goyal, A., & Sharma, K. (Eds.). (2023). Glycoside hydrolases: Biochemistry, biophysics, and biotechnology. Elsevier.
5. Rai, A. K., Sirohi, R., Vandenberghe, L. P. S., & Binod, P. (Eds.). (2023). Microbial enzymes in production of functional foods and nutraceuticals. CRC Press.
6. Kim, I. J. (2022). Enzyme catalysis: Advances, techniques, and outlooks. MDPI.
7. Belorkar, S. A., & Jogaiah, S. (2021). Protocols and applications in enzymology. Academic Press.
8. Whittall, J., & Sutton, P. W. (Eds.). (2020). Applied biocatalysis: The chemist's enzyme toolbox. Wiley.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: PRINCIPLES OF MICROBIOLOGY

Course code: P2BTTC203
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Objectives: In today's scientific world, microbiological studies have enriched knowledge of Molecular Biology and Biotechnology. This course has been designed to provide insight to students into the structure and function of microorganisms, microbial taxonomy, microbial genetics and application of microbial technology in food, medicine, environment, agriculture and industry.

Course Outcome:

After completing the course, students will able to:

CO1: Know general bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae

CO2: Understand the microbial diversity, taxonomy and nomenclature of microorganisms

CO3: Learn about the morphological and physiological characteristics of different groups of microorganisms

CO4: Understand use of microbial technology in areas of food, medicine, agriculture, environment etc.

UNIT- I: INTRODUCTORY MICROBIOLOGY

i. History and development of Microbiology, Methods in Microbiology, Pure culture techniques, Culture collection and maintenance of cultures

ii. Theory and practice of sterilization; Principles of microbial nutrition, Construction of culture media

iii. Enrichment culture techniques for isolation of Chemo–autotrophs, Chemo – heterotrophs and photosynthetic microorganisms

iv. Microbial growth: batch and continuous culture; Factors affecting growth.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

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Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

UNIT-II: MICROBIAL DIVERSITY, SYSTEMATICS AND METABOLIC DIVERSITY -I

i. Prokaryotic cell structure and function; Flagella and motility; cell inclusions like endospores, gas vesicles.

ii. Eukarya: Overview of Algae, Fungi, Slimemolds and Protozoa.

iii. Microbial taxonomy, Nomenclature and Bergey's manual.

iv. Prokaryotic diversity: Protobacteria, Cyanobacteria, Chlamydias, Cytophaga, Gram positive bacteria, Greensulphur bacteria, Green non-sulphur bacteria, Spirochaetes, Deinococci.

UNIT-III: MICROBIAL DIVERSITY, SYSTEMATICS AND METABOLIC DIVERSITY -II

i. Methods for determining evolutionary relationships. Ribotying and Ribosomal RNA sequencing.

ii. Metabolic diversity: Overview of basic metabolism. An overview ofPhototrophy, Chemolithotrophy.

iii. Anaerobic respiration and fermentation, Hydrocarbon oxidation, Nitrogen fixation.

iv. Syntrophy, Synergistic interactions in the microbs.

UNIT - IV: MICROBIAL DIVERSITY, SYSTEMATICS AND METABOLIC DIVERSITY - III

i. Archaea as earliest life forms, Halophiles, Methanogens, HyperthermophilicArchea, Thermoplasma.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: PRINCIPLES OF MICROBIOLOGY

Course code: P2BTTC203
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

ii. Viruses: Discovery, Classification and Structure of Viruses.

iii. Viruses of Prokaryotes and Eukaryotes. Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viriods and prions.

iv. Overview of important microbial diseases

UNIT-V: APPLIED MICROBIOLOGY

i. Industrial microorganisms and product formation: Major Industrial products for health industry Antibiotics, Vitamins, Aminoacids, Steroids, Enzymes

ii. Major Industrial Products for food and Beverage industry: Alcohol and Alcoholic beverages, Vinegar, Citric acid and other organic acids.

iii. Yeast as a food and food supplement, Mushrooms as a food source.

iv. Microbes as used in Genetic Engineering: Insulin, Protein Products, Recombinant Vaccines, Plants and Animals.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: PRINCIPLES OF MICROBIOLOGY

Course code: P2BTTC203
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: PRINCIPLES OF MICROBIOLOGY

Course code: P2BTTC203
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. Tortora, G.J., Funke, B.R. and Case (2020) Microbiology: An Introduction. Benzamin Cummings.
2. Moat's Microbial physiology (2016) Spector et al. Microbial Physiology Wiley- Liss a John Wiley and sons, Inc. Publication.
3. Prescott, L. M., Harley, J.P. and Klein, D. A. (2019) Microbiology. W.C.B.
4. Stainer, R.Y., Ingraham, J.L., Wheelis, M. L. and Painter, P.R. (1991) General Microbiology. The MacMillan press.
5. Madigan, M.T., Martinko, J.M. and Parker, J. (2007). Brock Biology of Microorganisms. J. Prentice Hall. 11th ed.
6. Pelczar, M. J., Chan, E.C.S. and Kreig, N.R. (1998) Microbiology. McGraw Hill.
2. Maloy, S. R., Cronan, J. E. and Freifelder, D. Microbial Genetics. Jones Barlett Publishers.
3. Cappuccino,J. G. and Sherman, N. (2003). Microbiology – A Laboratory Manual. Addison Wesley, Oxford.11th edition
4. Atlas, R. M. (2004), Microbiology: Fundamentals and Applications. Macmillan Publishing Co. New York. 2nd edition.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: PRINCIPLES OF MICROBIOLOGY

Course code: P2BTTC203
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

5. Salkia, R., Bora, C. and Bezbamah, K. L. (2008). Microbial Biotechnology. New India Publishing Agency.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: APPLIED BIOTECHNOLOGY

Course code: P2BTTE207	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1 hour	**Max. Marks: 100**
Minor Test2: 1 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

Course Objective: To equip students with in-depth knowledge and practical understanding of advanced topics in nanobiotechnology, green, white, red, and blue biotechnology, focusing on their applications, ethical considerations, and technological innovations.

Course Outcome:

CO1: Understand the core concepts and applications of major biotechnology branches.

CO2: Evaluate the role of biotechnology in sustainable agriculture and food security.

CO3: Explore marine and aquatic resources for sustainable biotechnological development.

CO4: Analyse modern medical biotechnology innovations and their healthcare impact.

CO5: Explore marine and aquatic resources for sustainable biotechnological development.

UNIT I: GREEN BIOTECHNOLOGY

i. Green Biotechnology, Introduction, History and Scope, Advantages
ii. Genetically Modified Crops: Introduction, benefits and threats
iii. Application of GMO's: Biopesticides, Bioinsecticides, Biofungicides, Bioherbicides, Biofertilizers
iv. Biofortification: Introduction and Case studies on Iron and Zinc rich crops, Increased protein content crops, Combating vitamin A deficiency crops

UNIT II: WHITE BIOTECHNOLOGY

i. Introduction to White Biotechnology: Definition, Scope, significance in Industrial Applications and Environmental Benefits.
ii. Microbial Cell Factories: Yeast, bacteria, and fungi in bioproduction
iii. Industrial Enzymes: Production, purification, industrial applications in food, textiles, pharmaceuticals
iv. Bioplastics and Biofuels: Development of biodegradable plastics, renewable fuels (microbial and enzymatic processes).

UNIT III: RED BIOTECHNOLOGY

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: APPLIED BIOTECHNOLOGY

Course code: P2BTTE207

Duration of Examinations

Minor Test1: 1 hour

Minor Test2: 1 hour

Major Test: 3.0 hours

Contact hours: 48

Credits: 4

Max. Marks: 100

Minor Test 1: 20

Minor Test 2: 20

Major Test: 60

Total: 100

i. Introduction to Red Biotechnology: Definition , Scope, significance in healthcare.
ii. Molecular Medicine: Gene therapy, RNA-based therapies: Monoclonal antibody therapies, Regenerative medicine and stem cells
iii. Diagnostics and Therapeutics: CAR-T cell therapy, Stem cell engineering for disease modeling, Molecular diagnostic (RT-PCR, CRISPR), Biosensors for health monitoring
iv. Advanced Applications: mRNA vaccine technology, nanocarriers and smart drug delivery systems, Biopharmaceutical pipeline development, Personalized medicine

UNIT IV: BLUE BIOTECHNOLOGY

i. Introduction to Blue Biotechnology: Definition, scope, significance in marine environments.
ii. Aquaculture Biotechnology: Developing disease-resistant fish strains, Fish vaccines, Sources in Aquafeed
iii. Marine Bioresources and Applications: Microalgae in Biofuels, CO capture, Marine bacteria in drug discovery, Marine-derived biomaterial
iv. Ocean Bioremediation & ethics: Marine pollution cleanup using engineered organisms, Marine biodiversity conservation, Ethical considerations in marine biotechnology

UNIT V: NANOBIOTECHNOLOGY

i. Overview of Nanobiotechnology: Definition, scope, and interdisciplinary applications in biology and medicine
ii. Nanomaterials: Classification, synthesis approaches (top-down and bottom-up), surface functionalization, nanotoxicity in biological systems.
iii. Characterization Tools: SEM, TEM, AFM, DLS, UV-Vis, and FTIR spectroscopy.
iv. Applications: nanofertilizers, nanopesticides, nanomedicine nano-vaccines, biosensors, and environmental remediation

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on	Syllabus to be	Time allotted for	%

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

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Credits: 4
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Total: 100

LMS + Subjective Test	**covered in the examination**	**the examination**	**Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	4 hours	50
External Examination	100%	4 hours	50
Total			100

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

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Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

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Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

References

1. Bhushan, B. (2017). Springer Handbook of Nanotechnology (3rd ed.). Springer.
2. Nel, A. E., &Madler, L. (2020). Nanoparticles and the Immune System. Elsevier.
3. Wong, J. E. M., &Spatz, J. P. (2018). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH.
4. Gupta, R. B., &Kompella, U. B. (2006). Nanoparticle Technology for Drug Delivery. Taylor & Francis.
6. Choudhary, D. K., Sharma, A. K., & Agarwal, P. (2017). Microbial-mediated Induced Systemic Resistance in Plants. Springer.
7. Srivastava, S., & Srivastava, A. K. (2013). Plant Biotechnology and Molecular Markers. Anamaya Publishers.
8. Pérez de Luque, A. (2017). Nanotechnology in Plant Science. Springer.
9. Malik, Z. A., et al. (2021). Green Biotechnology for Sustainable Agriculture. Springer.
10. Bhowmik, D., & Tripathi, A. (2023). Eco-friendly Nano-Hybrid Materials for Sustainable Agriculture. CRC Press.
12. Zhang, X., & Hua, Y. (2019). White Biotechnology: R&D and Business Perspectives. Springer.
13. El-Mansi, M., Bryce, C. F. A., Demain, A. L., & Allman, A. R. (2019). Fermentation Microbiology and Biotechnology (5th ed.). CRC Press.
14. Singh, O. V. (2010). Bio-nanotechnology: A Revolution in Food, Biomedical and Health Sciences. Wiley.
15. Koutinas, A. A., & Webb, C. (2013). White Biotechnology for Sustainable Chemistry. Royal Society of Chemistry.
16. Singh, B. D. (2019). Biotechnology: Expanding horizons (3rd ed.). Kalyani Publishers.
17. Glick, B. R., & Pasternak, J. J. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA* (4th ed.). ASM Press.
18. Cresswell, M. A. D., & Sweeney, L. F. (2005). *Red Biotechnology: A Handbook for Advanced Biomedical Research*. Springer.
19. Kim, S. K. (2013). *Marine Biotechnology: Enabling the Blue Revolution*. Springer.
20. Smith, J. L., & Bishop, R. L. (2009). *Marine Biotechnology in the Twenty-First Century: Problems, Promise and Policy*. National Academies Press.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: APPLIED BIOTECHNOLOGY

Course code: P2BTTE207
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

i. Bhattacharya, S., & Prajapati, P. K. (2021). *Nanotechnology in biology and medicine: Research advancements & future perspectives*. Springer.
ii. Wang, Y., &Xie, J. (2020). *Nanobiotechnology: Concepts, applications and perspectives*. Springer.
iii. Ahmad, A., Mukherjee, P., & Senapati, S. (2013). *Green synthesis of nanoparticles*. In *Nanotechnology in life sciences* (Vol. 2, Springer).
iv. Singh, J. S., & Pandey, V. C. (2018). *White biotechnology for sustainable chemistry*. Royal Society of Chemistry.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: HUMAN DISEASE BIOLOGY

Course code: P2BTTE208
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objectives: The course has been designed to provide knowledge to the students of Human Genetics about the importance of Genetics in medicine, various human mitochondrial diseases, study of human genetic diseases using animal model. Students will be taught inheritance patterns, of different genetic diseases. This course will make the students to learn about the management of human genetic diseases. Course will help the students to have knowledge about cancer, various cancer biomarkers and their role in therapeutics. Students will earn about genetic valuation and treatment of human infertility.

Course Outcome:

CO1: Explain the molecular and cellular basis of cancer.

CO2: Analyse critical signalling pathways and biomarkers involved in cancer.

CO3: Understand diseases caused by protein misfolding and structural malfunctions.

CO4: Identify the features and therapeutic interventions of rare genetic disorders.

CO5: Develop an integrated understanding of human disease mechanisms to inform diagnosis and treatment.

UNIT 1: FUNDAMENTALS OF CANCER

i. Hallmarks of cancer, Types and classification. process of carcinogenesis: initiation, promotion and progression, Metastasis.

ii. Oncogenes and proto-oncogenes, Tumor suppressor genes, Cell cycle regulation and checkpoints. Apoptosis and cancer.

iii. Signal transduction pathways in cancer (e.g., PI3K/AKT, MAPK, JAK-STAT), angiogenesis in cancer, Epithelial-mesenchymal transition (EMT).

iv. Cancer biomarkers, Cancer diagnostics, Cancer therapy, Drug resistance in cancer.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

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Duration of Examinations
Minor Test1: 1.0 hour
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Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

UNIT II: DISEASES DUE TO PROTEIN MALFUNCTIONS

i. Introduction to protein folding and proteosome removal of misfolded proteins.

ii. Aetiology and biochemical basis for Alzheimer's Disease.

iii. Sickle cell anaemia and Thalassemia – cause, Pathophysiology, Clinical Features, Diagnosis and treatment.

iv. Receptor and transport defects: Cystic fibrosis and familial hypercholesterolemia.

UNIT III: MICROBIAL PATHOGENS AND DISEASE MECHANISMS

i. Bacterial pathogens: Types, virulence factors, pathogenesis.

ii. Viral pathogens: Structure, replication, and mechanisms of viral diseases.

iii. Fungal and parasitic diseases: Overview of important fungal pathogens and parasites.

iv. Molecular mechanisms of pathogenicity: Adhesion, invasion, toxin production and Host immune evasion strategies by pathogens. Case studies: Tuberculosis, HIV/AIDS, Malaria.

UNIT IV: COMPLEX DISORDERS

i. Introduction to multifactorial disorders

ii. Neurodegenerative diseases: Parkinson, Alzheimer's,

iii. Mental Illnesses: Schizophrenia, bipolar disorders & depression

iv. Metabolic disorders: CVD, Hyperthyroidism, Obesity.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: HUMAN DISEASE BIOLOGY

Course code: P2BTTE208
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

UNIT V: RARE DISORDERS

i. Introduction to rare genetic diseases, Disorders amenable to Hematopoietic Stem CellTransplantation (HSCT): Lysosomal storage diseases.

ii. Disorders amenable to organ transplantation: Maple Syrup urine disease, Fabry disease.

iii. Disorders amenable to hormone/ specific drugs forms of therapy: Neonatal Onset Multisystem Inflammatory Disease (NOMID), Wilson's disease.

iv. Neurofibromatosis, Progeria, Werewolf syndrome, Skeletal dysplasia

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External	100%	2 hours	25

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: HUMAN DISEASE BIOLOGY

Course code: P2BTTE208
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
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Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Examination			
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: HUMAN DISEASE BIOLOGY

Course code: P2BTTE208
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

1. Carlberg C., Velleuer E. (2021) Cancer Biology: How Science Works. Springer International Publishing
2. Bellaire B. H., Kudva I. T., Bannantine J. P., Cornick N. A., Plummer P. J., Zhang Q., Nicholson T. L. (2020) Virulence Mechanisms of Bacterial Pathogens. Wiley
3. F Vogel A.G. Motulusky (2010) Human Genetics: Problems and Approaches. 5th Edition, BMC.
4. Helen M Kingston, (2015) ABC of Clinical genetics, 4th Edition, BMJ.
5. Robert Nussbaum et al. (2015) Thompson & Thompson genetics in Medicine, 8th Edition,Elsevier,
6. Micheal R. Cummings (2016) Human Heredity: Principles and Issues; 11th edition, 2016.
7. Emerys & Rimoin, Principles & amp (2019) Practice of Medical Genetics, 7th Edition, Elsevier
8. Huml R. A. (2021) Rare Disease Drug Development. Springer International Publishing.
9. Tylki-Szymańska A., Dooms M. M., Ayme S., Cox T. M. (2022) Prevention, Diagnosis and Treatment of Rare Disorders Frontiers Media SA
10. Gonzaga-Jauregui C., Lupski J. R. (2021) Genomics of Rare Diseases. Academic Press

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

COURSE TITLE: PROTEOMICS AND METABOLOMICS

Course code: P2BTTE209
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 10+10
Minor Test 2: 10+10
Major Test: 60
Total: 100

Course Objectives: Deciphering the protein population in an organism is among the elementary approaches in biological sciences. The course is envisaged to provide the student an understanding in proteomics and understanding of the basic metabolic processes involving major biomolecules in a cell and how these processes can be manipulated in a suitable living system for meeting the demands of various related industries, the different approaches and techniques employed in these fundamental fields of study.

Course outcome:

CO1: Understand the structure, properties, and separation of proteins.

CO2: Analyze proteomes using advanced electrophoresis and identification techniques.

CO3: Classify and extract key metabolites from biological systems.

CO4: Apply instrumental techniques for metabolite identification and quantification.

CO5: Evaluate the applications of proteomics and metabolomics in real-world contexts.

UNIT I: INTRODUCTION TO PROTEOMICS

i. Introduction to Proteins, Amino acids and their properties and analysis
ii. Basics of protein structure, Protein folding and misfolding
iii. Levels of Protein structure: primary, secondary, tertiary and quaternary, Protein organization
iv. Protein Separation Techniques: Chromatography and its types: ion-exchange, size-exclusion and affinity chromatography, applications of chromatography

UNIT II: PROTEOME ANALYSIS

i. Evolution from protein chemistry to proteomics, Proteome
ii. Analysis of proteomes - Two-dimensional polyacrylamide gel electrophoresis (2-DE), Fluorescence 2-D Difference Gel Electrophoresis (DIGE), Application of 2-DE and DIGE techniques in biological systems

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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Major Test: 60
Total: 100

iii. Protein identification: Mass spectrometry, Edman degradation, Western blotting.

iv. An overview of Protein Microarrays, Data bases and search engines for protein identification, challenges in proteomics

UNIT-III: METABOLISM AND METABOLITES

i. Metabolism: an overview, scope and applications.
ii. Metabolites: Primary and secondary metabolites, their properties. Extraction of metabolites and their functions.
iii. Metabolic regulation, Homeostasis, Metabolic control and analysis, Metabolic flux.
iv. Metabolome, Metabolomics and its resources. Metabolic engineering: Concept, scope, Feedback inhibition

UNIT-IV: METABOLITE IDENTIFICATION

i. Tools of metabolomics- Capillary electrophoresis, Gas chromatography, Electrochemical detectors
ii. Detecting and quantifying metabolites: Principle, protocol and applications of electrospray ionization (ESI), Matrix assisted laser desorption ionization (MALDI), and Fourier transform-ion resonance (FTIR).
iii. Principle, protocol and applications of liquid chromatography-mass spectrometry (LC-MS), Nuclear Magnetic Resonance (NMR) and its types.
iv. Metabolomic Data and its processing, Online metabolic databases (Human Metabolome Databases, KEGG, BioCyc) and pipelines.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Credits: 4
Max. Marks: 100
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Major Test: 60
Total: 100

UNIT V: APPLICATIONS OF PROTEOMICS AND METABOLOMICS

i. Proteomics in drug target discovery and development, and pharmaceutical applications
ii. Understanding protein- protein interactions (Yeast two-Hybrid system) for studying cellular processes
iii. Metabolomics approach for disease progression and identifying biomarkers, Environmental science and Toxicology.
iv. Agricultural and Plant metabolomics, Microbial metabolomics.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2026, May 2027 & May 2028

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Contact hours: 48
Credits: 4
Max. Marks: 100
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Major Test: 60
Total: 100

Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Credits: 4
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Major Test: 60
Total: 100

BOOKS RECOMMENDED

1. R. Hubert (2006) Protein Biochemistry and Proteomics (The Experimenter Series), Academic.
2. R. Westermeier, T. Naven, H-R. Höpker (2008) Proteomics in Practice: A Guide to Successful Experimental Design, Wiley-VCH.
3. Arthur Handley (2015) Proteomics: Advanced Concepts and Perspectives, Callisto Reference, USA
4. Lucio Comai, Jonathan E. Katz, Parag Mallick (2018) Proteomics: methods and protocols, Springer, New York
5. Joseph B. Lambert, Eugene P. Mazzola, Clark D. Ridge (2018) Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Applications, and Experimental Methods. Wiley
6. Paul L wood (2020) Metabolomics. Springer US.
7. Sanjeeva Srivastava (2022) From Proteins to Proteomics: Basic Concepts, Techniques, and Applications, CRC Press.
8. Vijay Soni, Travis E. Hartman (2023) Metabolomics: Recent advances and future applications. Springer Nature.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: BIOPROCESS TECHNOLOGY

Course code: P2BTTC301
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objective: This course is to introduce students to 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.

Course Outcome:

After completion of the course the students are:

CO1: Able to apply the principles of engineering and natural science in executing and developing bioprocesses for production of bio-based value-added commercial commodities such as materials food, feed, fuels, pharmaceutical, nutraceutical, biomaterials or biochemicals.

CO2: Able to design bioreactors, formulate and operate scaled-up bioconversion processes

CO3: Able to develop process control systems, instrumentation, and modelling.

CO4: Able to conduct practice-based tasks related to bioprocessing in a responsible, safe, voluntary, self-motivated and ethical manner.

UNIT - I: OVERVIEW OF BIOPROCESSING

i. Introduction to fermentation, bioprocess engineering and technology. Definition and scope of bioprocess engineering, Comparison: chemical and bioprocess
ii. Bioprocess based products of industrial importance, Kinetic of microbial growth and death, Methods for growth assay, types of fermentation/bioprocesses: batch, Fed-batch and continuous bioprocesses.
iii. Industrially important microorganisms, Isolation, Preservation and Maintenance of Industrial microorganisms.
iv. Media for industrial Fermentation, Sterilization of air and media.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

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Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

UNIT-II: BIOREACTORS, BIOPROCESS MONITORING AND CONTROL

i. Bioreactors, typical design of stirred tank reactor, non-agitated bioreactors, Specialized bioreactors-packed bed, fluidized bed, mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures.
ii. Bioprocess monitoring, and control for various process parameters, sensors, Role of computers in process monitoring, and control.
iii. Concept of scale up. Practical aspects and issues of process scale up, Bioprocess economics.
iv. Use of Microorganisms in mineral beneficiation and oil recovery.

UNIT-III: BIOPROCESS BASED INDUSTRIAL PROUDCTS

i. Alcohol (ethanol), bioethanol- Biofuel from sugary and non-sugary (starches, lignocelluloses) sources, organic Acids (citric, acetic and gluconic), Solvents (glycerol, acetone, butanol).
ii. Industrial enzymes (amylases, proteases, cellulases); Antibiotics (penicillin, streptomycin, teracycline).
iii. Aminoacids (lysine, glutamic acid), Single Cell Protein, Probiotics, and prebiotics.
iv. Biomass immobilization, approaches, merits, limitations, and Industrial Applications.

UNIT-IV: DOWNSTREAM PROCESSING AND EFFLUENT TREATMENT

i. Objectives and importance of Downstream processing (DSP), Classification and overview of downstream processes.
ii. Characteristics and location of the biological products (intracellular vs. extracellular), Methods for cell disruptions.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Major Test: 60
Total: 100

iii. Various unit operations, removal of microbial cells and solid matter, foam separation, Precipitation, filtration, centrifugation, sedimentation, chromatography, liquid-liquid extraction, membrane process, drying and crystallization.

iv. Pollution load of the effluent: B.O.D and C.O.D, Effluent treatment and disposal of effluents, types of reactors used for effluent treatment.

UNIT-V: FOOD TECHNOLOGY

i. Introduction to food technology, Food Processing Techniques: Sterilization and Pasteurization of food products,

ii. Food packing technology and elementary idea of canning and packing.

iii. Food preservation and hygiene, Hurdle concept, Hazard Analysis Critical Control Point (HACCP) System.

iv. Technology of Typical Food/Food products (bread, cheese, idli), Probiotics/prebiotics supplemented foods.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
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TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60

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M.Sc. Biotechnology

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Minor Test: 1 hours
Major Test: 3 Hours

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Credits: 4
Max. Marks: 100
Minor Test 1: 20
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Major Test: 60
Total: 100

Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
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Total			50

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Test I and Test II

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The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

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BOOKS RECOMMENDED

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M.Sc. Biotechnology

SEMESTER – III

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Minor Test: 1 hour

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Major Test: 3 Hours

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Major Test: 60

Total: 100

1. Carlson, R., & Morrissey, K. (2024). Bioprocess engineering principles (3rd ed.). Elsevier. Liu, S. (2022). Bioprocess engineering: Kinetics, sustainability, and reactor design (2nd ed.). Elsevier.
2. Kodali, V. P. (2022). Concepts in bioprocess engineering and industrial biotechnology. Mahi Publication.
3. Shuler, M. L., Kargi, F., & DeLisa, M. (2021). *Bioprocess engineering: Basic concepts* (3rd ed.). Pearson.
4. Show, P. L., Ooi, C. W., & Ling, T. C. (Eds.). (2020). Bioprocess engineering: Downstream processing.
5. Jerold, M., Arockiasamy, S., & Sivasubramanian, V. (Eds.). (2020). Bioprocess engineering for bioremediation: Valorization and management techniques. Springer.
6. Sivasubramanian, V. (Ed.). (2018). Bioprocess engineering for a green environment. CRC Press.
7. Poornima, B. (2017). Bioprocess engineering: Basic concepts. Pearson.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

COURSE TITLE: FUNDAMENTALS OF GENETICS AND GENOMICS

Course code: P2BTTC302
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course Objectives: In recent years, genetics and genomics have grown explosively, generating large amount of new information regarding the fine structure of gene and gene expression in pro- and eukaryotes. Besides, the genomic approaches are being adopted in altering genotype and tailoring plants and animals to answer human needs. This course will introduce students to the basic concepts of genetics and genomics and prepare them to appreciate the boom of biotechnology and their participation in the on-going revolution.

Course Outcome:

CO1: This course will help the students to understand the basic principles of inheritance and gene interaction and also to interpret the inheritance of characters using linkage and crossing over.

CO2: The course will make student understand the reason behind the cause of mutations and transposition which results in altered phenotypes in the population, leading to variations.

CO3: The course provides an understanding of different methods used in cytogenetics along with the concept of maternal inheritance.

CO4: The advanced techniques to be used in molecular biology and genomics which will be utilized by students in genetic and physical mapping of chromosomes, comparative genomics and genome analysis.

UNIT-I: GENETICS-I

i. Mendelian genetics: Laws of inheritance: Mendel's Laws, concept of dominance, segregation, independent assortment, Gene interaction and their types
ii. Chromosome theory of inheritance, tetrad analysis in *Neurospora crassa*, gene conversion
iii. Crossing over and Linkage, concept, molecular mechanism of crossing over, reciprocal and non- reciprocal recombination, Holliday Model of recombination
iv. Bacterial genetic system: transformation, transduction, conjugation and F-mediated sexduction, Site specific recombination.

UNIT-II: GENETICS-II

i. Mutation: Physical and Chemical mutagens, induction of mutations; molecular basis of mutations; detection of mutations

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

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Minor Test2: 1 hours
Major Test: 3 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

ii. Transposons; molecular characteristics of transposable elements in bacteria, Mechanism of transposition, Transposable elements in eukaryotes and prokaryotes
iii. Introduction to human genetics, Role of genetics in medicine, Patterns of single gene inheritance -autosomal recessive, Autosomal dominant
iv. Human pedigrees; X linked inheritance, Sex influenced and sex limited expression.

UNIT- III: GENETICS-III

i. Multiple alleles, Non disjunction; Dosage compensation.
ii. Sex determination; Role of Y chromosome; Genetic recombination; Maternal inheritance.
iii. Structural aberrations of chromosomes: deletions, duplications, inversions and translocation
iv. Molecular cytogenetics: Fluorescence in situ hybridization (FISH); Genomic in situ hybridization (GISH), Comparative Genomic Hybridization (CGH).

UNIT- IV: GENOMICS I

i. Molecular markers - hybridization and PCR based markers; RFLP, RAPD, STS, ESTs, SSR, AFLP, SNP markers
ii. DNA fingerprinting-principles and applications, Construction of high density linkage map and physical maps
iii. Gene pyramiding, Marker assisted Selection for major and minor genes, Fine mapping of the genes
iv. Chromosome walking and jumping, Human Genome Project, Genetic ethics

UNIT- V: GENOMICS II

i. Comparative genomics: method and applications, collinearity among the genomes
ii. Understanding evolution of eukaryotes, Orthologues and paralogues genes
iii. DNA microarrays: Concept, cDNA and oligonucleotide based microarrays, limitations and applications
iv. Concept of TILLING and Eco-TILLING, Pan-genomics: concept and applications

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

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Total: 100

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
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Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
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Total			100
Practical / Research (thesis/project/patent)			
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The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

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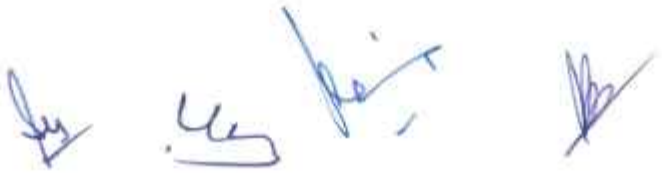
Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks



Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

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External Practical/ Research (thesis/project/patent) examination

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BOOKS RECOMMENDED

1. Lewin, B. (2017) Gene XII, John Goldstein and Stephen, Jones and Bartlett Publishers, Inc; 12th edition
2. Gardner, E.J., Simmons, M.J. and Snustad, D. P. (2006) Principles of Genetics. John Wiley and sons, New York.
3. Erich Grotewold, Joseph Chappell, Elizabeth a. kellogg (2015) plant genes, genomes and genetics. john wiley & sons
4. Michael Kaufmann, claudia klinger, andreas savelsbergh (2017) functional genomics methods and protocols, humana press, springer.
5. Arthur lesk (2017) introduction to genomics, oup oxford
6. Dale J.W. (2019) from genes to genomes concepts and applications of dna technology (3ed), Wiley india

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P2BTTC303
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Objective: The objective of this course is to familiarize the students with various problems concerning environment and their possible solutions employing the biotechnological approaches.

Course Outcome:

Upon the completion of the course students will have knowledge about

CO1: Components of environment, different types environmental pollution and issues related to global environmental change.

CO2: Conventional and non-conventional sources of energy

CO3: Microbiology and methods implemented to carry out waste water treatment

CO4: Solid waste management, concept of composting and soil erosion

CO5: Microbial intervention in mitigating the environmental pollution including the concept of bioremediation, biodegradation, biopollution, biomining.

UNIT- I: ENVIRONMENTAL BIOLOGY

i. Definition, principles and scope of ecology, human ecology and human settlements, ecosystem regulation, evolution of biosphere.
ii. Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes.
iii. Population ecology- population interactions- Mutualism, Parasitism, Predator-Prey relations,
iv. Earths major ecosystem - terrestial and aquatic ecosystem, Concepts and importance of microbial ecology in Environmental Biotechnology, Interactions in Microbial Ecosystems, Functions of microbial groups in Environmental engineering system

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P2BTTC303
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

UNIT- II: NATURAL ENVIRONMENTAL BIOTECHNOLOGY

i. Aquaculture Treatment: Water hyacinth system, Wetland System, Phytoremediation
Land treatment
ii. Facultative lagoons and Algal harvesting, Eutrophication: types and control
iii. Soil pollution management, Soil erosion and its control
iv. Biogeochemical cycles: Cycling elements, water cycle, carbon cycle, nitrogen cycle, phosphorus cycle, sulphur cycle. Impact of human activity on the cycling elements

UNIT – III: GLOBAL ENVIRONMENTAL ISSUES

i. Global environmental problems, Ozone depletion, Ultra Violet radiations, Green-house effect, acid rain
ii. Air pollution and Water pollution – causes, methods of monitoring and control
Waste water treatment - physical, chemical and biological treatment processes (Aerobic and Anaerobic)
iv.
iv. Treatment schemes for waste waters of dairy, distillery and antibiotic industries

UNIT-IV: SOLID WASTE MANAGEMENT

i. Solid waste management: Treatment and disposal of Solid waste.
ii. Aerobic (composting and vermicomposting), Anaerobic treatment of solid waste and biogas generation.
iii. Hazardous waste management, Sources and classification of hazardous waste, control and treatment, Handling rules.
iv. Environmental regulations and laws, International conventions, treaties and protocols for Biodiversity Conservation

UNIT-V: BIOREMEDIATION AND BIODEGRADATION

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-III

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Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P2BTTC303
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

i. Bioremediation: principle, concept and process.
ii. Bioremediation of contaminated soils and waste land, Spilled Hydrocarbons, Phytoremeditation.
iii. Biodegradation of Organic pollutants, Pesticides and Xenobioties. Biopesticides and Integrated Pest management.
iv. Biopollution, Biopolymers, Bioplastics and Biomining

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P2BTTC303
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

BOOKS RECOMMENDED

1. Rathoure, A.K. (2021) Industrial and Environmental Biotechnology. Horizon. Discovery Pub house.
2. De, A. K. (2018) Environmental Chemistry. 9th edition. Wiley Eastern Ltd. New Delhi
3. Moo-Young, M. (2011) Comprehensive Biotechnology, Pergamon Press, Oxford.
4. Arora, N. K., Sobti, R. C., Kothari, R. (2019) Environmental Biotechnology for Sustainable future. Springer Singapore
5. Metcalf L et al. (2010) Tchobanoglous, G., Franklin, B. and Stensel, H. D. (1991) Wastewater Engineering – Treatment, Disposal and Reuse, Tata McGraw Hill, New Delhi.
6. Allsopp, D. and Seal, K. J. (2010) Introduction to Biodeterioration, ELBS/Edward Arnold,
7. Kumar, A. (2004) Environmental Biotechnology. Daya publishing house.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P2BTTC303
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

8. Goel P.K. and Pathade G.R. (2004) Biotechnological applications in Environment and Agriculture. ABD Publishers.
9. Goel, P.K. (2003) Advances in industrial waste water treatment. ABD Publishers.
10. Cutter, S. L. (2003) Environmental risks and Hazards. Prentice Hall.
11. Ignacimuthu, S. (2003) Environmental Science. Phoenix Publishing house.
12. Pathade, G. R. and Goel, P.K. (2003) Biotechnology in Environmental Management. ABD Publications.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027, Dec. 2028

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P2BTTC304	**Contact hours: 24**
Credit: 2	**Max. Marks: 50**
Duration of Examinations	**Minor Test1:10**
Minor Test1: 1.0 hour	**Minor Test 2: 10**
Minor Test2: 1.0 hour	**Major Test: 30**
Major Test: 2.5 hours	**Total: 50**

Course Objectives: The last decade has seen veritable explosion of information generated by molecular biologists. To come in grips with the cascade of information knowledge of computers and their applications has become very important. Bioinformatics, loosely defined as interaction of molecular and computational biology, has to do this and to unravel more of nature's secrets. The present course has been designed to provide the students basic knowledge about statistical methods and bioinformatics.

Course outcome:

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

CO1: Gain broad understanding in Statistics

CO2: Recognize importance and value of statistical thinking, training, and approach to problem solving on a diverse variety of Biology

CO3: Develop an understanding of basic theory of computational tools

CO4: Gain working knowledge of computational tools and methods and how to use them to critically analyse and interpret results of any study.

CO5: Describe the contents and properties of most important bioinformatics databases

CO6: Perform text- and sequence-based searches and analyse and discuss the results in light of molecular biological knowledge;

CO7: Perform pair wise and multiple sequence alignment, explain the principle and execute pairwise sequence alignment by dynamic programming

CO8: Predict the secondary and tertiary structures of protein sequences.

CO9: Describe various approaches in genome sequencing like Sanger, NGS etc.

UNIT I: STATISTICAL METHODS AND INFERENCE

i. **Descriptive Statistics and Probability Fundamentals-** Measures of central tendency: Mean, median, and mode; Measures of dispersion: Range, variance, standard deviation; Fundamentals of probability: Definitions, types (classical,

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – III

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Major Test: 2.5 hours	**Total: 50**

empirical, and subjective); Combinatorics: Permutations and combinations; basic probability computations

ii. **Probability Distributions and Statistical Hypotheses-** Theoretical probability distributions: Binomial, Poisson, and Normal; Introduction to hypothesis testing: Null and alternative hypotheses; Statistical errors: Type I and Type II errors

iii. **Inferential Statistical Techniques-** Tests of significance: *t*-test (independent and paired), chi-square test; Analysis of variance (ANOVA): One-way and two-way ANOVA

iv. **Correlation and Regression Analysis-** Simple correlation: Concepts, calculation, and interpretation; Simple linear regression: Estimation of parameters, model interpretation; Application and limitations in predictive analysis.

UNIT II: BIOINFORMATICS AND BIOLOGICAL DATABASES

i. **Introduction to Bioinformatics-** Role of the internet in modern biological research; Scope and applications of bioinformatics in life sciences; Overview and classification of biological databases: Primary databases, Secondary databases, Composite database

ii. **Nucleotide Sequence Databases-** Structure, content, and access to major nucleotide databases: GenBank (NCBI), EMBL-EBI Nucleotide Sequence Database, DDBJ (DNA Data Bank of Japan)

iii. **Protein Sequence Databases-** Key repositories for protein sequence information; SWISS-PROT, TrEMBL, UniProt, PROSITE and Pfam, OWL

iv. **Structural Databases and Classification Systems-** Resources for macromolecular 3D structures: Protein Data Bank (PDB), Molecular Modelling Database (MMDB), Nucleic Acid Database (NDB); Structural classification systems: SCOP (Structural Classification of Proteins), CATH (Class, Architecture, Topology, Homologous superfamily)

UNIT III: INFORMATION RETRIEVAL AND COMPUTATIONAL ANALYSIS OF BIOLOGICAL DATABASES

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027, Dec. 2028

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P2BTTC304
Credit: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

Contact hours: 24
Max. Marks: 50
Minor Test1:10
Minor Test 2: 10
Major Test: 30
Total: 50

i. **Data Retrieval Systems-** SRS (Sequence Retrieval System) for flat-file databases, ENTREZ (NCBI) global search platform, LinkDB for pathway and link-based data retrieval.
ii. **Sequence Analysis and Submission Tools-** Sequence similarity tools: BLAST, FASTA, CLUSTALW; Sequence submission: BankIt, Sequin, Webin, SAKURA
iii. **Genomics and the Human Genome Project-** Overview of the Human Genome Project, latest advancements: T2T consortium, Human Pangenome Reference Consortium (HPRC), Genome India Project (GIP). Genome sequencing and mapping techniques, Applications of genome maps.
iv. **Genome and Phylogenetic Analysis-** Sequence assembly and genome annotation, Phylogenetic analysis methods; Comparative genomics: COGs and HomoloGene (NCBI)

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027, Dec. 2028

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P2BTTC304
Credit: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

Contact hours: 24
Max. Marks: 50
Minor Test1:10
Minor Test 2: 10
Major Test: 30
Total: 50

External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED:

1. Baxivanis, A.D. and Francis Onellete, B.F. (2020) Bioinformatics. Wiley Interscience, John Wiley and sons New York.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027, Dec. 2028

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P2BTTC304	**Contact hours: 24**
Credit: 2	**Max. Marks: 50**
Duration of Examinations	**Minor Test1:10**
Minor Test1: 1.0 hour	**Minor Test 2: 10**
Minor Test2: 1.0 hour	**Major Test: 30**
Major Test: 2.5 hours	**Total: 50**

2. Lesk, AM (2019). Introduction to Bioinformatics 5th edition. Oxford University press.
3. Higgs PG, Attwood T.K. (2013) Bioinformatics and Molecular Evolution. Blackwell Publications
4. Zweig G, Sherma J (2016) Principles, statistics and applications: Analytical methods. Academy Press.
5. Attwood, T.K. and Parry- Smith, D.J. (1999) Introduction to bioinformatics. Pearson Education, Singapore.
6. Curtin, D.P. et. al., (1999). Information technology. Tata McGraw-Hill Publishing Company, New Delhi.
7. Dhar M.K. and Kaul, S (1997) Statistics in Biology. Malhotra Brothers, Jammu.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

Semester: III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY | **Contact hours:24**
Course code: P2BTTE308 | **Max. Marks: 50**
Minor: 1.0 hours | **Minor Test 1: 10**
Major: 1.0 hours | **Minor Test 2: 10**
Major: 3.0hours | **Major Test: 30**
Total: 50

Course Objective : Is to Enable students with the knowledge and skills to apply artificial intelligence (AI) techniques to solve complex problems and drive innovation in biology. Encourage students to think critically and creatively to develop basic AI tools that address real-world biological challenges.

Course Outcome:

CO1. Understand the fundamentals of Artificial Intelligence and its relevance in biological sciences.

CO2. Identify and classify different types of biological data and their associated computational challenges.

CO3. Apply data management and preprocessing techniques to biological datasets.

CO4. Understand the principles of machine learning and deep learning in the context of biology.

CO5. Gain proficiency in AI programming tools, languages, and frameworks for biology.

UNIT 1: INTRODUCTION TO AI, BIOLOGICAL DATA, AND DATABASES

i. Artificial Intelligence and Its Foundations Definition and history of AI; Branches of AI: Machine Learning (ML), Deep Learning (DL): AI vs. traditional programming: Generative AI: ChatGPT, DeepSeek: AI vs. Biological Intelligence

ii. Biological Data; Types of biological data: imaging, experimental, clinical and environmental: Challenges in biological data analysis

iii. Computational Tools and Data Management, Need for computational tools in biology: Data storage and analysis: Cloud vs. server-based data storage and analysis: Data privacy and security: Algorithmic bias and fairness: Sources of bias in biological datasets

iv. Data Processing Techniques: Data cleaning and handling: Dealing with missing values, noise, and outliers: Data transformation: Normalization, standardization and scaling of data

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

Semester: III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY | **Contact hours:24**
Course code: P2BTTE308 | **Max. Marks: 50**
Minor: 1.0 hours | **Minor Test 1: 10**
Major: 1.0 hours | **Minor Test 2: 10**
Major: 3.0hours | **Major Test: 30**
Total: 50

UNIT 2: MACHINE LEARNING AND DEEP LEARNING

i. Machine learning; Types of ML: Supervised, unsupervised, Reinforcement learning; Use cases in biology: AlphaFold, trRosetta, AIDDISON; Common tools and libraries: BioPython, EMBOSS, etc.
ii. Deep learning; Basics of neural networks: Neurons, layers, weights (conceptual)
iii. Deep Learning architectures, CNNs and RNNs: Applications, advantages, and limitations in biology
iv. Programming languages: Python, BioPython, R, Shell/Bash; Practical examples and hands-on coding exercises. Programming without coding

UNIT 3: APPLICATIONS IN BIOLOGY

i. Bioinformatics: Overview of commonly used AI-based tools and databases for nucleic acid, protein, metabolite analysis
ii. Drug discovery and development: Target identification and validation: Lead discovery and optimisation: Preclinical and clinical trial data analysis: Personalized medicine: Drug repurposing using molecular and clinical data
iii. Diagnostics and precision medicine: Analysis of medical images (e.g., X-rays, MRIs, CT scans) using CNNs: Genomic data analysis for diagnosis and subtyping of disease
iv. Agricultural and environment: Crop yield prediction; Disease and pest detection; Resource optimisation (e.g., water, fertilizers); Environmental monitoring and sustainability. Ethical principles and bias in AI applications for biology

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30	20%	1 hour	5 + 5

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

Semester: III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY **Contact hours:24**
Course code: P2BTTE308 **Max. Marks: 50**
Minor: 1.0 hours **Minor Test 1: 10**
Major: 1.0 hours **Minor Test 2: 10**
Major: 3.0hours **Major Test: 30**
Total: 50

days)			
TEST II (after 60days)	21 to 40%	1 hour	5+ 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2hours	25
External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

Semester: III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY — **Contact hours:24**
Course code: P2BTTE308 — **Max. Marks: 50**
Minor: 1.0 hours — **Minor Test 1: 10**
Major: 1.0 hours — **Minor Test 2: 10**
Major: 3.0hours — **Major Test: 30**
Total: 50

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. "In Silicon Dreams: How Artificial Intelligence and Biotechnology Will Create the Medicines of the Future" by Brian S. Halibut (WILEY, Publisher) 1st Edition 2021,ISBN-113:978-1119745570 ISBN-10:1119745578
2. NEXT-GEN BIOLOGY: Ai's Transformative Impact On Life Sciences: Ai Innovations In Biotechnology, Healthcare, And Agriculture" by Anita Margret A,Chrisanne Freeman,Merlyn Diana A S (2025) ISBN-10:9365542308 ,ISBN:13:978-93655542301
3. Future of AI in Biomedicine and Biotechnology" edited by Shankar Mukundrao Khade and Raj Gaura Mishra (2024) **IGI GLOBAL** Publisher, ISBN-13:979-8369354827
4. BIOTECHNOLOGICAL APPROACH TO SUSTAINABLE FARMING (AI-Driven Agriculture)" by Dr. ALOK KUMAR SRIVASTAV et al. (2023) ISBN-10,9355455534,ISBN-13,978-9355455536
5. Think Python: How to Think Like a Computer Scientist" by Allen B. Downey (**Shroff/O'Reilly** ,Publisher 2016) ISBN -10,9789352134755,ISBN-13,978-9352134755
6. Python Crash Course: A Hands-On, Project-Based Introduction to Programming" by Eric Matthes (2019) ISBN-10:1593279280,ISBN-13:978-1593279288
7. Machine Learning For Absolute Beginners: A Plain English Introduction" by Oliver Theobald
8. Machine Learning For Dummies" by John Paul Mueller and Luca Massaron (**Dummies** ,Publisher 2016)ISBN-10:1119245516,ISBN-13:978-1119245513

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

Semester: III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY	**Contact hours:24**
Course code: P2BTTE308	**Max. Marks: 50**
Minor: 1.0 hours	**Minor Test 1: 10**
Major: 1.0 hours	**Minor Test 2: 10**
Major: 3.0hours	**Major Test: 30**
	Total: 50

9. Grokking Deep Learning" by Andrew W. Trask (**Manning** Publisher, 2019) ISB-10:1617293709,ISBN-13:978-1617293702

10. "Neural Networks and Deep Learning" by Charu C. Aggarwal (**Springer** , Publisher 2018)ISBN -10:3319944622 , ISBN-13:978-3319944623

11. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

12. R Programming for Dummies" by Andrie de Vries and Joris Meys (**Wiley** Publisher ,2016)ISBN-10:8126562188,ISBN-13:9788-8126562183

13. R for Data Science" by Hadley Wickham and Garrett Grolemund (**Shroff/O'Reilly**,Publisher 2017) ISBN-10:9789352134977,ISBN-13:978-9352134977

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P2BTTE309
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hour

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

Course Objective: This course aims to provide students with a comprehensive understanding of genomics and microbiomics, focusing on the structure, function, and evolution of genomes, as well as the composition and role of microbial communities in health, disease, and the environment. Students will learn the principles and methods used in genome sequencing, bioinformatics analysis, and microbiome profiling. Through lectures, case studies, and hands-on analysis, students will develop the skills to critically evaluate scientific literature and conduct basic genomic and microbiomic data analysis.

Course Outcome:

CO1: Understand the principles and platforms of Next Generation Sequencing (NGS).

CO2: Interpret sequencing data formats, quality, and data submission protocols.

CO3: Operate computing platforms and tools for genomic data analysis.

CO4: Analyze transcriptomic data and perform gene expression studies.

CO5: Explore epigenomic modifications and their impact on gene regulation.

UNIT - I: INTRODUCTION TO NEXT GENERATION SEQUENCING AND DATA ANALYSIS

i. **Next generation sequencing (NGS) technologies:** overview, principal, sequencing chemistry and their types; Short read sequencing: Illumina, Ion torrent; Concept of single and pair end; Long read sequencing: Pacific BioSciences, Oxford Nanopore Technologies; Hybrid sequencing approaches.
ii. **Sequence formats:** FASTA, FASTQ, GenBank, EMBL, XML, FAST5; Sequencing quality and coverage estimation; Overview of sequence databases; Data submission: NCBI SRA, NCBI Genomes, bio-project, accessions.
iii. Introduction to High Performance Computing and servers, specifications of workstations needed for NGS analysis, Data retrieval from sequencing using wget, FTP, FileZilla
iv. Introduction to Linux, Windows vs Linux, basic commands for file handling on Linux, processing, installation of data analysis software.

UNIT - II: INTRODUCTION TO GENOMICS

i. **Genomics:** C-value content and genome size: estimation methods, genome coverage, Sequencing and preprocessing, assembly: de-novo and reference based assembly, genome assemblers; assembly algorithms: de-Bruijn graph and Over-Layout Consensus (OLC); Assembly statistics: N50, L50, genome coverage, Genome completeness estimation, Contigs, Scaffolds, Pseudochromosome and Chromosome

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P2BTTE309
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hour

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

ii. **Genome Annotation:** Gene prediction: tools and models, genome annotations: determining the functions of individual genes; functional databases
iii. **Comparative Genomics:** Synteny and whole-genome alignment, Molecular phylogenetics and phylogenomics, Adaptive evolution; Concept of Pangenomes and Super reference genome; Core genome and accessory genome, population genomics
iv. **Genome wide association studies (GWAS):** Overview, Identifying genetic associations; Statistical Association Testing, Rare variant analysis; Genotyping

UNIT - III: FUNCTIONAL GENOMICS AND EPIGENOMICS

i. **Transcriptomics**: Biological replicates and controls; Sampling methods and RNA extraction, RIN value, rRNA depletion and mRNA enrichment; Short-read vs long-read sequencing (Illumina, PacBio, ONT); RNA-seq data analysis: de-novo and reference based transcriptome assembly; Read Alignment and Quantification: RPKM, FPKM, TPM, normalization; differential expression analysis; Functional Enrichment and Pathway Analysis; Single-cell transcriptomics.
ii. **Whole exome sequencing**: Genomic vs exomic sequencing; Exome enrichment and sequencing, Reference alignment, Variant calling and annotation, copy number variants (CNVs). Applications of WES in disease research, clinical diagnostics, and personalized medicine, Ethical considerations and societal implications of WES
iii. **Epigenomics**: Introduction to Epigenetics: DNA methylation, histone modifications, and ATP-dependent chromatin remodelling, ChIP-seq, ATAC-seq, Bisulfite-seq, MeDIP-seq, etc, Data alignment, Peak Calling and Annotation, Differential peak analysis, Functional Interpretation and Integration, Single-Cell Epigenomics
iv. **Genome projects**: The Human genome project, HapMap Project, The 1000 genome project, The Human Epigenome Project (HEP), The Genome India Project (GIP) and The ENCODE Project

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P2BTTE309
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hour

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			100

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

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Course code: P2BTTE309
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hour

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. TA Brown (2023) Genomes 5 (5th edition) CRC press, ISBN 9780367674076
2. RC Sobti, Manishi Mukesh, Aastha Sobti (2023) Genomic, Proteomics, and Biotechnology, CRC press, ISBN 9781003220831
3. Jonathan Pevsner (2015) Bioinformatics and Functional Genomics (Third Edition) Department of Neurology, Kennedy Krieger Institute, Baltimore, Maryland, USA
4. Arthur M. Lesk (2012) Introduction to Genomics 2nd Edition, Oxford University Press, New York
5. Jamil Momand and Eliot Bush (2025) Concepts in Bioinformatics and Genomics (Second Edition) Oxford University Press, New York, ISBN: 9780198882381
6. Filippo Geraci, Indrajit Saha, Monica Bianchini (2020) RNA-Seq Analysis: Methods, Applications and Challenges, Frontiers Media SA, ISBN: 9782889637058, 2889637050
7. Richard C. Deonier, Simon Tavare, Michael S. Waterman, (2005) Computational Genome Analysis: An Introduction. Springer India

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec 2028

COURSE TITLE: MICROBIOMICS

Course code: P2BTTE310
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test: 1.0 hours
Major Test: 2.5 hours

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

Course Objective: This course aims to provide students with a comprehensive understanding of microbiomics, focusing on the composition and role of microbial communities in health, disease, and the environment. Students will learn the principles and methods used in bioinformatics analysis and microbiome profiling. Through lectures, case studies, and hands-on analysis, students will develop the skills to critically evaluate scientific literature and conduct basic microbiomics data analysis.

Course Outcome:

CO1: Understand the principles and technologies of Next Generation Sequencing (NGS).
CO2: Manage and process sequencing data using appropriate formats and computing platforms.
CO3: Explore the diversity and ecological roles of microbiomes across environments.
CO4: Apply culturomics and metagenomic approaches to study unculturable microorganisms.
CO5: Analyse metagenomic data for taxonomic and functional insights.

UNIT - I: INTRODUCTION TO NEXT GENERATION SEQUENCING AND DATA ANALYSIS

i. Next generation sequencing (NGS) technologies: overview, principal, sequencing chemistry and their types; Short read sequencing: Illumina, Ion torrent; Concept of single and pair end; Long read sequencing: Pacific BioSciences, Oxford Nanopore Technologies; Hybrid sequencing approaches.
ii. Sequence formats: FASTA, FASTQ, GenBank, EMBL, XML, FAST5; Sequencing quality and coverage estimation; Overview of sequence databases; Data submission: NCBI SRA, NCBI Genomes, bio-project, accessions.
iii. Introduction to High Performance Computing and servers, specifications of workstations needed for NGS analysis, Data retrieval from sequencing using wget, FTP, FileZilla
iv. Introduction to Linux, Windows vs Linux, basic commands for file handling on Linux, processing, installation of data analysis software.

UNIT - II: INTRODUCTION TO MICROBIOMICS

i. Microbiomics: Overview of microbial diversity across different habitats, Host-Microbe Interactions, Human microbiome, extreme habitats microbiome, Plant

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

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Duration of Examinations
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Major Test: 2.5 hours

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

microbiome, Concept of Holobiome; Human Microbiome Project and Earth Microbiology Project, The Earth BioGenome Project

ii. Culturomics: Isolation & cultivation of microbes, identification based on morphology, microscopy, biochemical characterization and molecular characterization, media engineering to cultivate yet to be cultured microorganism

iii. Metagenomics: Great plate anomaly, Metagenomic DNA extraction and sequencing, Sequencing quality and metagenome coverage estimation; Metagene centric approach (Metabarcoding, 16S rRNA, housekeeping genes): ASV vs OTU estimation, 16S rRNA; ITS databases and custom databases; Taxonomy databases and algorithm; diversity indices, alpha/beta diversity.

iv. Whole metagenome centric approach: metagenome assembly: algorithms and assemblers, downstream annotation: functional metagenomic databases and softwares; taxonomic classification and functional annotation; Pathway analysis; Comparative metagenomics; Concept of pan-microbiome, core microbiome and lineage specific microbiome

UNIT - III: METAGENOME ASSEMBLED GENOME AND METATRANSCRIPTOMICS

i. Metagenome assembled genomes (MAGs): Binning & Genome Reconstruction, bin contamination and completeness; MAG annotations, MAGs Databases, softwares and algorithms; Synthetic genomes and their applications: Genomic stability, Regulatory and societal implication, Intellectual property

ii. Metatranscriptomics: Overview of metatranscriptomics and its significance in microbial ecology, metatranscriptomics RNA extraction, rRNA depletion and mRNA enrichment; transcriptome sequencing, assembly and annotation, differential gene expression

iii. Metagenome-Wide Association Studies: Concept of MWAS, difference between MWAS and GWAS;

iv. Applications of microbiomics: Microbiome-based therapies and personalized medicine, Case study of MWAS in health, agriculture, and environment

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

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Duration of Examinations
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Credits: 2
Max. Marks: 50
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Total: 50

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER – III

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Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. Zhong Wang (2022) Introduction to Computational Metagenomics World Scientific Publishing Company. ISBN: 9789811242489, 9811242488
2. Rolf Daniel, Wolfgang R. Streit (2018) Metagenomics: Methods and Protocols Springer New york. ISBN: 9781493982745, 1493982745
3. John Parkinson, Robert G. Beiko, Will Hsiao (2018) Microbiome Analysis: Methods and Protocols. Springer New York. ISBN: 9781493987283, 1493987283

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course code: P2BTTC401	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.0 hour	**Max. Marks: 100**
Minor Test2: 1.0 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

Course Objectives: This course introduces students to molecular and cellular immunology, including antigen and antibody structure and function, major histo-compatibility complexes, B- and T- cell receptors, antibody formation and immunity and regulation of immune system. Students will understand how the innate and adaptive immune systems function to protect the body from disease and what happens when the immune system breaks down, leading to immunodeficiency and autoimmunity. Also students will learn immunology concepts that are linked to the treatment of disease.

Course Outcome:

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

CO1: Understand fundamental concepts of human immune system and basic immunology

CO2: Identify the cellular and molecular basis of immune responsiveness.

CO3: Distinguish various cell types involved in immune responses and associated functions

CO4: Describe the roles of the immune system in both maintaining health and contributing to disease.

CO5: Differentiate and understand immune responses in relation to infection and vaccination

CO6: Understand Immune tolerance and principles of autoimmunity

CO7: Demonstrate knowledge and practice of common immunological laboratory procedures used to detect and measure the immune response

CO8: Demonstrate knowledge of the mechanisms of T Cell and B cell maturation, activation, and differentiation in cell mediated immune responses

CO9: The students will be able to transfer knowledge of immunology into clinical decision

UNIT - I: INTRODUCION TO THE IMMUNE SYSTEM

i. Introduction to immune system, Innate and acquired immunity, clonal nature of immune response; Organization and structure of lymphoid organs
ii. Hematopoiesis and differentiation, Cells of the immune system: B- lymphocytes, T lymphocytes, Macrophages, Dentritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.
iii. Nature and Biology of antigens and super antigens, Antibody structure and function, antibody mediated effector functions, antibody classes and biological activity

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

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Minor Test1: 1.0 hour | **Max. Marks: 100**

Minor Test2: 1.0 hour | **Minor Test 1: 20**

Major Test: 3.0 hours | **Minor Test 2: 20**

Major Test: 60

Total: 100

iv. Antigenic determinants on immunoglobulins, Immunoglobulin superfamily, BCR & TCR, generation of antibody diversity.

UNIT - II: HUMORAL AND CELL MEDIATED IMMUNITY

i. Regulation of immune response, Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B- and T- lymphocytes,
ii. Complement System: components of complement, complement activation, complement cascade, regulation of complement System
iii. Cytokines, cytokines receptors, cytokines antagonists, role of cytokines in TH1/TH2 subset development and their role in immune regulation, MHC: MHC molecules and genes, MHC restriction,
iv. Cell-mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.

UNIT - III: FAILURE OF THE IMMUNE SYSTEM

i. Autoimmunity and auto immune disorders: organ specific and systemic autoimmune diseases, animal models for autoimmune diseases and the molecular mechanism, immunodeficiency disorder- AIDS
ii. Hypersensitivity: IgE mediated Hypersensitivity, Antibody mediated cytotoxic Hypersensitivity, Immune comlex- mediated Hypersensitivity, Delayed type Hypersensitivity
iii. Transplantation immunology: Immunological basis of graft rejection, clinical manifestation of graft rejection, general immunosuppressive therapy, specific immunosuppressive therapy, immune tolerance to allografts
iv. Immunological tolerance: central tolerance, peripheral tolerance, component of peripheral tolerance

UNIT IV: IMMUNODIAGNOSTIC PROCEDURES

i. Antigen- Antibody interactions and Techniques – ELISA and its variants, ELISPOT, Radio immunoassay, Immunofluorescence, Flow cytometry and Fluorescence, Immunoelectron microscopy
ii. Agglutination and haemagglutination assays
iii. Types of immundiffusion and immunoelectrophoretic procedures, isolectric focusing
iv. Affinity chromatographic methods and Immunoblotting.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

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Course code: P2BTTC401 | **Contact hours: 48**

Duration of Examinations | **Credits: 4**

Minor Test1: 1.0 hour | **Max. Marks: 100**

Minor Test2: 1.0 hour | **Minor Test 1: 20**

Major Test: 3.0 hours | **Minor Test 2: 20**

Major Test: 60

Total: 100

UNIT - V: IMMUNOLOGY-BASED THERAPIES

i. Immunotherapy: CAR T-cell therapy, Immune checkpoint inhibitors, Monoclonal antibodies, interleukine therapy, vaccines
ii. Chimeric antigen receptor (CAR) T-cell therapy: working, application and side effects, approved CAR T-cell therapies
iii. Hybridoma Technology and Monoclonal antibodies detection and application of monoclonal antibodies;
iv. Vaccines: History of vaccine development, introduction to the concept of vaccine, Active and passive immunization, Designing vaccines for active immunization: Conventional vaccines, subunit vaccines, conjugate vaccines, DNA vaccines, RNA vaccines, Recombinant vector vaccines

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

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Duration of Examinations | **Credits: 4**

Minor Test1: 1.0 hour | **Max. Marks: 100**

Minor Test2: 1.0 hour | **Minor Test 1: 20**

Major Test: 3.0 hours | **Minor Test 2: 20**

Major Test: 60

Total: 100

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

1. Kuby Immunology; 8th Edition 2023 By Jenni Punt & Sharon Stranford
2. Cellular And Molecular Immunology 10th Edition 2022 By Abul K Abbas
3. Paul's Fundamental Immunology by Martin Flajnik, Publisher: Wolters Kluwer Health; 8th edition (19 October 2022)
4. Immunology, International 9th Edition 2020 by David Male

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

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Minor Test2: 1.0 hour | **Minor Test 1: 20**

Major Test: 3.0 hours | **Minor Test 2: 20**

Major Test: 60

Total: 100

5. Coleman, R.M., Lombard, M.F. and Sicard, R.E. (1992). Fundamental Immunology. Wm. C. Brown publishers, USA.
6. Roitt, I., Brostoff, J. and Male, D. (1999). Immunology. Hartcourt Brace and Company, Asia Pte. Ltd.
7. Benjamini, E., Coico, R., and Sunshine, G. (2000). Immunology – a short course. John Wiley and Sons. Inc., New York.
8. Davies. (1997). Introductory Immunology. Chapman and Hall, New York
9. Bratke & Myrtek (2007). Immunology: The experimenter series.Elsener Pub.
10. Wood, Peter (2008). Understanding Immunology Elseiver Pub. 2nd edition.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: FUNDAMENTALS OF PLANT BIOTECHNOLOGY

Course code: P2BTTC402	**Contact hours: 24**
Duration of Examinations	**Credits: 2**
Minor Test1: 1 hour	**Max. Marks: 50**
Minor Test2: 1 hour	**Minor Test 1: 10**
Major Test: 2.5 hours	**Minor Test 2: 10**
	Major Test: 30
	Total: 50

Course Objectives: Plant Biotechnology is increasingly being used in the fields of health, productivity and genetic improvement. This course will introduce students to some of the biotechnological techniques applied in the development of genetically enhanced crops and use of some sustainable practices.

Course Outcome:

CO1: This course deals with biotechnological aspects of different methods used in plant tissue culture which ensures the production of economically important viable plants on vegetative mode in a less time duration, as compared to the conventional methods.

CO2: The course provides an understanding of different methods used in protoplast isolation and fusion and need for the conservation of germplasm using cryopreservation.

CO3: The course discusses about cloning vectors and genetic transformation using direct and indirect different methods of gene transfer in plants. They will also learn about trans gene stability and gene silencing.

CO4: The course discusses about different applications of genetic transformation in plant productivity and performance. Students will become familiar about the production of sterile seeds using terminator gene technology.

CO5: The course will help the students to acquire knowledge about plant primary and secondary metabolites and regulation of metabolic pathways. Students will become familiar with a broad range of molecular markers and will thus develop platform for molecular breeding experiments.

UNIT-I: TISSUE CULTURE

i. History of Plant Tissue Culture, micropropagation, multiplication, transfer and establishment of whole plants in soil, applications
ii. Initiation and maintenance of callus and suspension culture; somatic embryogenesis, Shoot-tip culture; Embryo culture and embryo rescue
iii. Anther, pollen and ovary culture for production of haploid plants, wide hybridization and homozygous lines

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

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Course code: P2BTTC402 | **Contact hours: 24**

Duration of Examinations | **Credits: 2**

Minor Test1: 1 hour | **Max. Marks: 50**

Minor Test2: 1 hour | **Minor Test 1: 10**

Major Test: 2.5 hours | **Minor Test 2: 10**

Major Test: 30

Total: 50

iv. Protoplast isolation: mechanical and enzymatic method, purification, fusion, applications

UNIT-II: GENETIC TRANSFORMATION

i. Plant Transformation technology: Basis of tumor formation, hairy roots, features of T1 and R1 plasmids.
ii. Mechanisms of DNA transfer, role of virulence genes, use of T1 and R1 as vectors, binary and co-integrate vectors.
iii. Promoters, Vectorless or direct DNA transfer, particle bombardment, electroporation, microinjection. In plant transformation.
iv. Transformation in monocots; multiple gene transfers, Transgene stability and gene silencing; Genome editing and case studies on agricultural advancements

UNIT-III: APPLICATIONS OF PLANT BIOTECHNOLOGY

i. Application of plant transformation for productivity and performance; herbicide resistance, insect resistance, virus resistance.
ii. Male sterile lines, bar and barnase systems, long shelf life of fruits and flowers, Edible vaccines
iii. Plant secondary metabolites and their role, phenylpropanoid pathway, alkaloids
iv. Biodegradable plastics, industrial enzymes, terminator gene technology

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

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Course code: P2BTTC402 | **Contact hours: 24**

Duration of Examinations | **Credits: 2**

Minor Test1: 1 hour | **Max. Marks: 50**

Minor Test2: 1 hour | **Minor Test 1: 10**

Major Test: 2.5 hours | **Minor Test 2: 10**

Major Test: 30

Total: 50

Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	12.5
External Examination	100%	2 hours	12.5
Total			25

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

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External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department,

M.Sc. Biotechnology

SEMESTER IV

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Duration of Examinations	**Credits: 2**
Minor Test1: 1 hour	**Max. Marks: 50**
Minor Test2: 1 hour	**Minor Test 1: 10**
Major Test: 2.5 hours	**Minor Test 2: 10**
	Major Test: 30
	Total: 50

concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED:

1. Fasella, P., & Hussain, A. (2017). Plant biotechnology (2nd ed.). Meditech Science Press.
2. Abdin, M. Z., Kiran, U., Kamaluddin, & Ali, A. (2017). Plant Biotechnology: Principles and applications. Springer.
3. Chawla, H.S. (2020). An Introduction to Biotechnnology, 3rd Ed, Oxford and IBH Publishing
4. Gibson, A. (2022). Plant biotechnology: The genetic manipulation of plants. States Academic Press.
5. Razdan, M. K. (2005). An introduction to plant tissue culture. Oxford and IBH Publishing.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P2BTTC403 | **Contact hours: 24**

Duration of Examinations | **Credits: 2**

Minor Test1: 1.0 hour | **Max. Marks: 50**

Minor Test2: 1.0 hour | **Minor Test 1: 10**

Major Test: 2.5 hours | **Minor Test 2: 10**

Major Test: 30

Total: 50

Course outcome: Animal Biotechnology aims to equip students with a thorough understanding of animal cell culture, genetic engineering, genomics, and their biotechnological applications. The program emphasizes practical skills, research, and critical thinking to drive advancements in biotechnology and foster sustainable solutions in animal health and agriculture.

Course Outcome:

CO1: This course is designed to give students a perspective on cutting edge biotechnologies that can be used for animal and human health and research.

CO2: Course enable them to develop basic skills for cell culture, maintenance of cell lines and various media used for cell culturing

CO3: Enable to understand the principles of animal cloning, tissue engineering, stem cell technology, animal reproductive biotechnology and their applications

UNIT I: FUNDAMENTALS OF ANIMAL CELL CULTURE

i. Introduction to Animal Cell Culture: Historical background and scope, essential equipment, sterilization, and aseptic techniques.
ii. Cell Culture Techniques: Primary and secondary cultures, monolayer and suspension cultures, cell lines, Characteristics of cells in culture, growth and maintenance.
iii. Culture Media and Preservation: Types and composition of media (serum-based and serum-free), contamination control, tissue disaggregation, cryopreservation techniques.
iv. Scale-Up and Cell Assays: Techniques for scaling up cultures (anchorage-dependent and suspension), transformation and immortalization, Cell cloning, cell synchronization.

UNIT II: ANIMAL REPRODUCTIVE BIOTECHNOLOGY AND BIOETHICS

i. Reproductive Technologies: Gamete structure and function, Cryopreservation of gametes, Artificial Insemination (AI), IVF, embryo culture, embryo manipulation and transfer.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P2BTTC403
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

ii. Animal Cloning: Somatic Cell Nuclear Transfer (SCNT), generation of transgenic animals, gene knockout/knock-in transgenic model, models for disease research.
iii. Animal Genomics: Basic of animal genomic, Genomic Tools, genome databases and bioinformatics tools (e.g., Ensembl, NCBI Genome Browser), Gene Editing Techniques
iv. Ethical and Regulatory Issues: Ethical aspects of gene therapy, cloning, and stem cell use; biosafety measures; regulatory frameworks for GMOs and animal biotechnology.

UNIT III: APPLICATIONS OF ANIMAL CELL CULTURE

i. Biopharmaceutical Production: Virus isolation, drug screening, toxicity testing, cell-based production of vaccines, monoclonal antibodies (hybridoma technology), therapeutic proteins.
ii. Stem Cell Technologies: Stem cell types (embryonic, adult, iPSCs) and its culturing, gene therapy in genetic disorders (cystic fibrosis, hemophilia).
iii. Tissue Engineering: 3D cell culture, scaffold fabrication, biomaterials, artificial organs, Lab-grown tissues, bioprinting.
iv. Molecular Markers and Diagnostics: Molecule markers (SNP, QTLs, STRs); animal pathogens detections, genetic markers for disease resistance and QTL mapping; detection of meat adulteration.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P2BTTC403
Duration of Examinations
Minor Test1: 1.0 hour
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Major Test: 2.5 hours

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	12.5
External Examination	100%	2 hours	12.5
Total			25

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P2BTTC403 | **Contact hours: 24**

Duration of Examinations | **Credits: 2**

Minor Test1: 1.0 hour | **Max. Marks: 50**

Minor Test2: 1.0 hour | **Minor Test 1: 10**

Major Test: 2.5 hours | **Minor Test 2: 10**

Major Test: 30

Total: 50

to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED:

1. Freshney RI. *Culture of animal cells: A manual of Basic Technique*. 5th ed. John Wiley & Sons Inc.; 2007.
2. Sivakumar ADL, Sivakumar SM. *Biotechnology of Animal Reproduction*. 1st ed. Cambridge: Cambridge University Press; 2018. p. 320. ISBN 978-1107152884.
3. Gordon I. *Reproductive Techniques in Farm animals*. CABI; 2005.
4. Portner R. *Animal Cell Biotechnology*. Humana Press; 2007.
5. Springer TA. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press; 1985.
6. Bloom BR, Lambert P-H. *The Vaccine Book*. Academic Press; 2002.
7. Krishna VS. *Bioethics and Bioethics in Biotechnology*. New Age International (P) Limited; 2007.
8. Gupta NK. *Animal Cell Culture and Biotechnology: Methods and Applications*. 1st ed. Cham: Springer; 2017. p. 232. ISBN 978-3319509325.
9. Choudhury HN, Anwar MA. *Principles of Animal Biotechnology*. 1st ed. Boca Raton: CRC Press; 2020. p. 340. ISBN 978-0367331475.
10. Sevilha AMVL. *Transgenic Animals in Agriculture*. 1st ed. Dordrecht: Springer; 2007. p. 288. ISBN 978-1402054246.
11. Glick BR, Pasternak JJ. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. 5th ed. Washington: ASM Press; 2017. p. 512. ISBN 978-1555819203.
12. Singleton WT, Srinivasan KSB. *Animal Genomics: Principles and Applications*. 1st ed. Hoboken: Wiley; 2019. p. 540. ISBN 978-1119510879.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

Course Title: BIOENTREPRENEURSHIP
Course code: P2BTTE407
Course Credits: 2
Duration of Examinations:
Minor Test 1: 1 hour
Major Test: 2.5 hours

Contact hours: 24
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

Course Objectives:

This course will provide an in-depth understanding of bioentrepreneurship, focusing on the intersection of biotechnology, innovation, and business strategies. The course covers the essential aspects of starting, managing, and scaling a biotechnology company, including market analysis, financing, regulatory considerations, and commercialization strategies. Students will engage with case studies, develop business plans, and explore real-world examples of successful biotech startups.

Course Outcome:

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

CO1. Define and explain the concept of bioentrepreneurship and evaluate its relevance and scope in biotechnology and allied life sciences.

CO2. Identify innovative opportunities in biotechnology and apply out-of-the-box thinking to explore emerging technologies and business models.

CO3. Analyse different entrepreneurial domains (agri-biotech, pharma-biotech, microbial biotech, etc.) and assess the basic characteristics and motivation factors for becoming an entrepreneur.

CO4. Develop a business plan addressing feasibility, financial management, statutory/legal requirements, and partnership strategies.

CO5. Identify funding opportunities and differentiate between various financial instruments like seed money, venture capital, angel investing, government schemes (BIRAC, SISFS, etc.).

UNIT -I INTRODUCTION TO BIOENTREPRENEURSHIP

i. Overview of Bioentrepreneurship; Definition, scope, and importance of bioentrepreneurship.

ii. Integration of science, technology and business for bioentrepreneurship; creativity; innovation – types, out of box thinking

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-IV

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Minor Test 1: 1 hour
Major Test: 2.5 hours

Contact hours: 24
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

iii. Various Entrepreneurial opportunities in Biotechnology/Microbiology/ Biochemistry; New evolving areas in Biotechnology

iv. Social and business entrepreneurship; basic characteristics of entrepreneurship; Developing entrepreneurship through training and motivation

UNIT -II MANAGING ENTREPRENEURSHIP

i. Translating scientific research into commercially viable products; IP and technology transfer from academic/research institutions

ii. Business plan preparation including statutory and legal requirements, Business feasibility study, financial management, collaborations and partnerships

iii. Assessment of market demand for potential product(s) of interest; Market conditions, segmentation; Identifying needs of customers including gaps in the market.

iv. Branding issues; Developing distribution channels; Pricing/Competition; Promotion/ Advertising

UNIT -III DEVELOPING A BUSINESS MODEL FOR STARTUPS

i. Development and upgradation of technology, Quality control; Regulatory Compliances and procedures

ii. Concept of startups and associated challenges, stages of startups, incubation centre, acceleration centre

iii. Understanding the biotech venture funding lifecycle: Seed money, venture capital, angel investors, government grants, and crowdfunding.

iv. Startups/companies working in different areas of specialization (agri-based, pharma -based etc.); Case studies of successful biotech startups.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-IV

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Contact hours: 24
Max. Marks: 50
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Major Test: 30
Total: 50

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**(%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. Biotechnology

SEMESTER-IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

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Minor Test 1: 1 hour
Major Test: 2.5 hours

Contact hours: 24
Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50

BOOKS RECOMNDEDDED:

1. Gupta A, George G, Fewer TJ; (2024) Venture Meets Mission: Aligning People, Purpose, and Profit to Innovate and Transform Society, Stanford Business Books.
2. Ahmetoglu et al., (2017) The Wiley handbook of entrepreneurship, John Wiley and sons.
3. Craig S; (2020) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Academic Press (Elsevier), UK.
4. Patzelt, H, Brenner T; (2008) Handbook of Bioentrepreneurship, Springer Publications.
5. Hopkins T and Perui O; (2019) The smart start up, Jaico publishing house, Mumbai
6. Zaware N; (2018) Entrepreneurship development and start up management, Educreation publishing, New Delhi
7. Bhatt AK, Bhatia RK, Bhalla TC; (2023) Basic Biotechniques for Bioprocess and Bioentrepreneurship, Academic Press Inc.
8. Shimasaki C; (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Academic Press.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

Course Title: IPRS AND BIOETHICS
Course code: P2BTTE408
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

Contact hours: 24
Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

Course objectives: This course will cater to various aspects of IPR like procedure, limit and variety of patent laws. Further it will also address bioethical concerns arising from the commercialization of biological products, GM foods, stem cell research, organ transplantation etc.

Course Outcome:

CO1: Students will gain knowledge about the basics of the primary forms of intellectual property rights, the right of ownership, scope of protection as well as the ways to create and to extract value from IP.

CO2: Students will able to analyze the effects of intellectual property rights on society as a whole.

CO3: Students will able to understand different aspects of bioethical issues arises due to advancement in Biotechnology.

UNIT-I: INTELLECTUAL PROPERTY

i. Introduction to IPRs; various types of IPRs: Trademarks, Copyrights, Geographical indications, Trade Secrets; Role of IPRs in Biotechnology

ii. Patents: Criteria for patenting in Biotechnology/Microbiology/Biochemistry: novelty, non-obviousness, and utility; Patentable and non-patentable inventions; Biological Patents; Purpose of patents

iii. *Sui generis* system of IPRs: Need for *Sui generis* system; Plant variety protection, Database protection, other forms of *Sui generis* protection

iv. Introduction to WIPO and TRIPS, various provisions in the TRIPS Agreement; Indian legislations for the protection of various types of IPs; National Biodiversity protection initiatives

UNIT-II: PATENTING PROCESS

i. Specific challenges in biological patenting: gene patents, diagnostic patents and biopharmaceuticals patents

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
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Contact hours: 24
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Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

ii. Patent application: various components of Patent application, patent search, patent filing, Pre grant and post grant opposition, Patent Cooperation Treaty (PCT)

iii. Introduction to Indian patent office, US patent office and European patent office

iv. Patent Licensing; Technology Transfer; The role of technology transfer offices in academic and research institutions; Patent Infringement

UNIT-III: BIOETHICS

i. Introduction to Bioethics, Statement of Bioethical Principles; Rules and regulations of ethical issues in India

ii. Traditional knowledge and bioethics; Gene therapy: Somatic genome editing; Germ line Gene therapy Moratorium; Medical privacy and genetic discrimination

iii. Bioethics in research: Stem cells, animal cloning; Use of animals in research, animal rights; Human experimentation; Organ transplantation

iv. Genetically Modified foods: Environmental risk, labelling and public opinion; Protection of environment and biodiversity; Biopiracy, case studies

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5+ 5
Theory	Syllabus to be covered in the	Time allotted for the examination	%Weightage (Marks)

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
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Major Test: 2.5 Hours

Contact hours: 24
Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

	examination		
Major test (after 90 days)	100%	2.5 hours	30
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

BOOKS RECOMNDEDDED:

1. Keswani C and Possas C (2024); Intellectual Property Issues in Life Sciences: Disputes and Controversies, CRC Press USA
2. Stasi A and David TWC (2023); An Introduction to Legal, Regulatory and Intellectual Property Rights Issues in Biotechnology, Bentham Science Publishers UAE.
3. Pattinson S; (2025) Medical Law and Ethics (7th Edition), Sweet & Maxwell Publishers, ISBN: 9780414125070

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
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Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

4. Goodwin M, Tu S, Paris J J. (2015) Biotechnology, Bioethics and the Law. LexisNexis
5. Kornyo E. A. (2017) A Guide to Bioethics. CRC Press, USA.
6. Ahuja VK (2015) Intellectual Property Rights in India Lexis, Nexis, and New Delhi.
7. Padma N; (2017) An introduction to Ethical, Safety and intellectual property rights issues in Biotechnology, Academic press (Elsevier), UK.
8. Singh HB, Jha A and Keswani C; (2016) Intellectual property issues in Biotechnology, CABI, UK.

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION

Course code: P2BTTE409
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2: 1.0 hour
Major Test: 2.5 Hours

Contact hours: 24
Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

Course objective: The objectives of this course are to give background on history of science, emphasizing methodologies used to do research, use framework of these methodologies for understanding effective lab practices and scientific communication and appreciate scientific ethics.

Course Outcome:

CO1.To explain the philosophy of science and describe the principles of empirical and experimental research, including the use of controls.

CO2. Identify a potential research area, distinguish between original vs incremental research, and assess its significance and impact.

CO3. Design a research process involving hypothesis formulation, experiment planning, and appropriate statistical controls.

CO4. Use internet tools effectively for scientific data search, including search engines, the hidden web, and science forums.

CO5. Prepare formal and scientific documents, including reports, proposals, and research papers with proper layout and organization.

CO6. Identify common challenges in scientific writing, recognize plagiarism, and use plagiarism detection software appropriately.

UNIT I: SCIENCE METHODOLOGIES

i. The philosophy of science; Empirical science, manipulative experiments and controls
ii. Deductive and inductive reasoning; Reductionist vs holistic biology
iii. Identifying a research area of interest, importance of originality and impact, exploratory versus incremental research
iv. The research process, hypothesis testing, experimental design

UNIT II: PROCESS OF COMMUNICATION

i. Concept of effective communication- setting clear goals for communication; Determining outcomes and results

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
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Contact hours: 24
Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

ii. Initiating communication; Preparing and presenting using PowerPoint; Scientific poster preparation & presentation
iii. Computing skills for scientific research - web browsing for information search; Search engines and their mechanism of searching
iv. Hidden Web and its importance in scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness.

UNIT III: SCIENTIFIC COMMUNICATION

i. Technical writing skills - types of reports; layout of a formal report; Scientific writing skills - importance of communicating science;
ii. Problems while writing a scientific document; plagiarism, Software for plagiarism
iii. Scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts
iv. Publishing scientific papers - peer review process and problems, recent developments such as open access and nonblind review; characteristics of effective technical communication; scientific presentations; ethical issues, scientific misconduct.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
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Major Test: 30 marks
Total: 50 marks

Major test (after 90 days)	100%	2.5 hours	30
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

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Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

BOOKS RECOMMENDED:

1. Thomas G. C. (2021) Research methodology and scientific writing. Springer International Publishing.
2. Kahan D. M., Scheufele D., Jamieson K. H. (2017) The Oxford handbook of the science of science communication. Oxford University Press.
3. Besley J. C., Dudo A. (2022) Strategic Science Communication. Johns Hopkins University Press, USA.
4. S. P. Mukherjee (2019) A Guide to Research Methodology. CRC Press, USA.
5. On Being a Scientist: a Guide to Responsible Conduct in Research. (2009). Washington, D.C.: National Academies Press.

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Major Test: 30 marks
Total: 50 marks

6. Mohan, K., & Singh, N. P. (2010). Speaking English Effectively. Delhi: Macmillan India.
7. Movie: Naturally Obsessed, The Making of a Scientist

Syllabus for the 2 years PG Programme as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-IV
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: FUNCTIONAL NUTRACEUTICALS

Course code: P2BTTE410
Credits: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

Contact hours: 24
Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

Course Objectives: This course explores the biochemical and molecular foundations of human nutrition, focusing on nutrient-gene interactions, metabolic regulation, clinical implications of nutrient deficiencies and excesses, and current developments in nutraceuticals and functional foods. Students will gain insights into the biochemical basis of nutrient metabolism and the role of nutrition in health, disease prevention, and therapeutic strategies.

Course Outcome:

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

CO1. Differentiate between nutrigenomics and nutrigenetics and explain the role of genetic and epigenetic mechanisms in nutrition.

CO2. Explain the molecular mechanisms behind metabolic disorders like diabetes, obesity, and metabolic syndrome, including mitochondrial dysfunction and bioenergetics.

CO3. Apply knowledge of molecular techniques (e.g., PCR, SNP analysis, gene expression profiling) in the context of nutritional genomics research. CO4. Assess the role of hormones (leptin, ghrelin, insulin, etc.) and signalling pathways (AMPK, mTOR, PPARs) in metabolism and appetite regulation.

CO5. Explain the functions and responsibilities of FSSAI and DCGI in regulating food and pharmaceutical products in India.

UNIT 1: NUTRIENT-GENE INTERACTIONS AND NUTRITIONAL GENOMICS

i) Nutrigenomics vs Nutrigenetics, Classification and biochemical mechanisms of nutraceuticals.
ii) Role of genetic polymorphisms in nutrient metabolism (e.g., MTHFR and folate metabolism), Epigenetic modifications influenced by diet (DNA methylation, histone modification).
iii) Molecular basis of metabolic disorders: Diabetes, Metabolic Syndrome, Obesity, Bioenergetics, and mitochondrial function in nutrition.
iv) Molecular techniques in nutritional genomics research.

UNIT 2: HORMONAL AND MOLECULAR REGULATION OF METABOLISM AND EATING BEHAVIOUR

COURSE TITLE: FUNCTIONAL NUTRACEUTICALS

Course code: P2BTTE410
Credits: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

Contact hours: 24
Max. Marks: 50
Minor Test1: 10 marks
Minor Test 2: 10 marks
Major Test: 30 marks
Total: 50 marks

i) Hormonal regulation of appetite: Ghrelin, leptin, insulin, PYY, GLP-1; Nutrient sensing pathways (e.g., SIRT1, AMPK).
ii) Hormonal control of carbohydrate, lipid, and protein metabolism (insulin, glucagon, cortisol, leptin, ghrelin), Signal transduction pathways (e.g., mTOR, AMPK, PPARs).
iii) Neuro-biochemistry of food intake and reward system (dopamine, serotonin pathways) and Eating-disorders: biochemical and metabolic consequences. Biochemical response to fasting, starvation, and refeeding syndrome.
iv) Clinical biomarkers of nutritional status (serum proteins, lipid profile, vitamin levels), Biochemical basis of malnutrition and overnutrition.

UNIT 3: ADVANCED THERAPEUTIC NUTRITION OF IMMUNE AND GUT HEALTH

i) Dietary supplements: Efficacy, safety, regulatory aspects; Concept of Parenteral and enteral nutrition: Biochemical considerations in formulation and delivery.
ii) Overview of Microbiome-nutrient interactions, Biochemistry of Probiotics, prebiotics, and synbiotics.
iii) Gut-associated lymphoid tissue (GALT) and nutrition; Gut microbiota and its metabolic products (SCFAs, bile acids); Nutrient absorption and metabolism with aging, Role of dietary fiber in immune-gut axis; and Leaky gut syndrome and nutritional modulation.
iv) FSSAI: Overview, functions, food safety regulations, licensing, and recent developments. DCGI: Role in drug regulation, clinical trials, approval processes, and quality control of pharmaceuticals.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5

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Major Test: 30 marks
Total: 50 marks

Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

BOOKS RECOMMENDED:

1. Haslberger, A.G. 2022. Advances in Precision Nutrition, Personalization and Healthy Aging. Hardcover ISBN 978-3-031-10152-6, Softcover ISBN 978-3-031-10155-7.
2. Litwack, G. 2021. Human Biochemistry. Academic Press. ISBN: 9780323910538
3. Biswas, D., and Rahaman, S.O.(Eds.). 2020. Gut Microbiome and Its Impact on Health and Disease. Springer.
4. Nelson, D. L., and Cox, M. M. (2017). Lehninger Principles of Biochemistry. W.H. Freeman and Company.
5. Ferguson, L.R. 2014 (e-book 2016). Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition. CRC Press.

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6. Watson, R.R., Preedy, V.R. 2015. Probiotics, Prebiotics, and Synbiotics: Bioactive Foods in Health Promotion. Academic Press. ISBN-10: 0128021896
7. Litwack, G. (Ed.). 2008. Human Biochemistry and Disease. Academic Press. ISBN 978-0-12-452815-4.
8. Kaput, J., and Rodriguez, R. L. (2006) Nutritional genomics: Discovering the path to personalized nutrition. Wiley-Interscience.

Syllabus for the 2 years PG Programme as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-IV

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: RESEARCH PROJECT
Course code: P2MBTE411 **Contact hours: 192**
Duration of Examinations **Credits: 16**
Max. Marks: 400
Dissertation: 200
Presentation and Viva: 200

COURSE OBJECTIVE:
This course bridges theoretical learning with real-world problem-solving, enabling postgraduate students to apply their academic knowledge through hands-on research projects. Students will develop critical thinking, strengthen data analysis skills, and cultivate a problem-solving mindset. Emphasis is placed on self-directed learning, fostering research competencies, and gaining advanced knowledge through project-based study.

COURSE OUTCOMES:
Upon completion of the project work course, student will be able to
CO1: Apply academic concepts and theoretical knowledge to address real-world problems.
CO2: Demonstrate research competencies, including literature review, data collection, data analysis, and interpretation of results.
CO3: Draw meaningful conclusions from research findings and present them effectively.
CO4: Communicate research outcomes clearly in written, oral, and visual formats.
CO5: Collaborate effectively in teams, demonstrating strong interpersonal and time management skills.
CO6: Exhibit readiness for professional roles or advanced academic research through enhanced problem-solving and self-directed learning abilities.

Scheme of Research Project and Dissertation

Allotment of Supervisor
Each student shall carry out a project work in one of the broad areas of Microbiology in the semester IV 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.

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SEMESTER-IV

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Journal clubs: In order to make students aware of the latest research & developments in their allotted research project, students have to select and present a recent research paper published in high impact journal preferably related to the ongoing research project. Journal clubs enhance the student's ability to analyze study design, methodology, data interpretation, and conclusion. A well-structured presentation has to be made and presented it in front of the faculty members in 10-20 minutes time.

Project Writing:
Project writing is a structured way of presenting research ideas, work plans in a clear, organized format so that others can understand, evaluate, for financial support. Project writing improves writing, critical thinking, and presentation skills. Student has to write and present an idea for research project which will be evaluated subsequently by faculty members.

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.

1. Abstract
2. Content Page
3. List of Figures
4. List of Tables
5. Acknowledgement
6. 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:

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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.

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.

Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

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Max. Marks: 400

Dissertation: 200

Presentation and Viva: 200

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):

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/Institutes

2. The students shall be declared pass in the research project course if she/he secures minimum 40% marks (Dissertation and viva).

Syllabus for the 2 years PG Programme as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-IV

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ANNEXURE-I

CERTIFICATE

The work embodied in this dissertation entitled " .... ** (write the title in capital letters) has been carried out by me under the supervision of .... (give the name of the Guide).

This work is original and has not been submitted byme for the award of any other degree of University of Jammu or any other University. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated.

.....

.....
(Signature and Name of the Candidate)

Date: .....
Place: .....

Syllabus for the 2 years PG Programme as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-IV

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Presentation and Viva: 200

ANNEXURE-II

CERTIFICATE OF DISSERTATION GUIDE/SUPERVISOR

I certify that the candidate /Mr./Ms./Mrs ..... has planned and conducted the research study entitled "..... ....." under my guidance and supervision and that the report submitted herewith is a genuine, original, and bonafide work done by the candidate in ..... (Place) from..... to ..... (Dates). ....

(Signature and Name of the Supervisor)
Date : .....
Place.....

.....
Name, Signature of HoD