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./10)

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 **Microbiology** 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
Microbiology	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
Microbiology	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/25/10838-850
Dated: 09/10/25

Copy for information and necessary action to:

1. Dean, Faculty of Life- Science
2. Convener, Board of Studies in **Biotechnology/Biochemistry/Microbiology**
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

Rebecca 7/10/25
Joint Registrar (Academic)
7/10/25 7/10/25

SYLLABI FRAMEWORK PG PROGRAMME MICROBIOLOGY (2 YEAR)

PG Syllabi 2025

S. No.	Course No.	Course Title	No. of Credits	Credits Level	Credit Points	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.	P2MBTC101	Fundamental of Molecular Biology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
2.	P2MBTC102	Cellular Biology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
3.	P2MBTC103	Basics of Biochemistry and Metabolism	4	6.5	26	Core	100	-	✓	✓	✓	✓			
4.	P2MBPC104	Laboratory course in Fundamental of Molecular	2	6.5	13	Core	-	50	✓	✓	✓	✓			
5.	P2MBPC105	Laboratory course in Cellular Biology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
6.	P2MBPC106	Laboratory course in Basics of Biochemistry and Metabolism	2	6.5	13	Core	-	50	✓	✓	✓	✓			
7.	P2MBTE107	Molecular Virology and Vaccinology	4	6.5	26	Elective	100	-	✓	✓	✓	✓			
8.	P2MBTE108	Analytical techniques in Biology	4	6.5	26	Elective	100	-	✓	✓	✓				
9.	P2MBTE109	Micronutrients and Mammalian Hormones	4	6.5	26	Elective	100	-	✓	✓	✓	✓			
10.	P2MBTE110	Laboratory course in Molecular Virology and Vaccinology	2	6.5	13	Elective	-	50	✓	✓	✓				
11.	P2MBTE111	Laboratory course in Analytical techniques in Biology	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
12.	P2MBTE112	Laboratory course in Micronutrients and Mammalian Hormones	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
13.	P2MBTC201	Recombinant DNA technology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
14.	P2MBTC202	Enzyme and enzyme technology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
15.	P2MBTC203	Fundamentals of Bacteriology and virology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
16.	P2MBPC204	Laboratory course in Recombinant DNA technology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
17.	P2MBPC205	Laboratory course in Enzyme and enzyme technology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
18.	P2MBPC206	Laboratory course in Fundamentals of Bacteriology and Virology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
19.	P2MBTE207	Applied Biotechnology	4	6.5	26	Elective	100	-	✓	✓	✓	✓			
20.	P2MBTE208	Human diseases biology	4	6.5	26	Elective	100	-	✓	✓	✓	✓			
21.	P2MBTE209	Proteomics and Metabolomics	4	6.5	26	Elective	100	-	✓	✓	✓	✓			
22.	P2MBTE210	Laboratory course in Applied Biotechnology	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
23.	P2MBTE211	Laboratory course in Human diseases and disorders*	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
24.	P2MBTE212	Laboratory course in Proteomics and Metabolomics	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
25.	P2MBVC251	Industrial technology	4			Vocational	-	-	✓	✓	✓	✓			
26.	P2MBVC252	Diagnostic Techniques in Biochemistry and Microbiology	4			Vocational	-	-	✓	✓	✓	✓		✓	
27.	P2MBTC301	Bioprocess Technology	4	6.5	26	Core	100	-	✓	✓	✓	✓		✓	

28	P2MBTC302	Fundamental of Mycology and Phycology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
29	P2MBTC303	Food and Environmental Microbiology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
30	P2MBPC304	Fundamental of Bioinformatics and Biostatistics	2	6.5	13	Core	50	-	✓	✓	✓	✓			
31	P2MBPC305	Laboratory course in Bioprocess Technology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
32	P2MBPC306	Laboratory course in Fundamental of Mycology and Phycology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
33	P2MBTE307	Laboratory course in Fundamental of Bioinformatics and Biostatistics	2	6.5	13	Core	-	50	✓	✓	✓	✓			
34	P2MBTE308	Artificial Intelligence in Biology	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
35	P2MBTE309	Computational Genomics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
36	P2MBTE310	Microbiomics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
37	P2MBTE311	Lab Course in Artificial Intelligence in Biology	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
38	P2MBTE312	Lab Course in Computational Genomics	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
39	P2MBTE313	Lab Course in Microbiomics	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
40	PSMBMO351	MOOCs Course	4	6.5	13	Core	100	-	✓	✓	✓	✓	✓		
41	P2MBTC401	Immunology and Immunotechnology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
42	P2MBTC402	Clinical Microbiology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
43	P2MBPC403	Laboratory course in Immunology and Immunotechnology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
44	P2MBPC404	Laboratory course in Clinical Microbiology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
45	P2MBTE406	IPRs and Bioethics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
46	P2MBTE407	Bio Entrepreneurship	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
47	P2MBTE408	Research methodology and Scientific communication	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
48	P2MBTE409	Functional Nutraceuticals	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
49	P2MBRC410	Research Project (Project presentation +Viva-Voce + Dissertation)	16	6.5	52	Core	400	-	✓	✓	✓	✓			

SCHEME FOR 2 YEARS PG PROGRAM AS PER NEP 2020

M.SC. MICROBIOLOGY

Total credits= 102

Semester I

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC101	Fundamental of Molecular Biology	4
P2MBTC102	Cell Biology	4
P2MBTC103	Basics of Biochemistry and Metabolism	4
P2MBPC104	Laboratory course in Fundamental of Molecular	2
P2MBPC105	Laboratory course in Cellular Biology	2
P2MBPC106	Laboratory course in Basics of Biochemistry and Metabolism	2
	Electives*	
P2MBTE107	Molecular Virology and Vaccinology	4
P2MBTE108	Analytical techniques in Biology	4
P2MBTE109	Micronutrients and Mammalian Hormones	4
P2MBTE110	Laboratory course in Molecular Virology and Vaccinology	2
P2MBTE111	Laboratory course in Analytical techniques in Biology	2
P2MBTE112	Laboratory course in Micronutrients and Mammalian Hormones	2
TOTAL		24

*Student will opt for only one elective along with respective laboratory course

Student will register for a 4-credit course from MOOCs platform and complete it by the end of 3rd Semester

Semester II

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC201	Recombinant DNA technology	4
P2MBTC202	Enzyme and enzyme technology	4
P2MBTC203	Fundamentals of Bacteriology and virology	4
P2MBPC204	Laboratory course in Recombinant DNA technology	2
P2MBPC205	Laboratory course in Enzyme and enzyme technology	2
P2MBPC206	Laboratory course in Fundamentals of Bacteriology and Virology	2
	Electives	
P2MBTE207	Applied Biotechnology	4
P2MBTE208	Human diseases biology	4
P2MBTE209	Proteomics and Metabolomics	4
P2MBTE210	Laboratory course in Applied Biotechnology	2
P2MBTE211	Laboratory course in Human diseases and disorders*	2
P2MBTE212	Laboratory course in Proteomics and Metabolomics	2
	Vocational*	
P2MBVC251	Industrial technology	4
P2MBVC 252	Diagnostic Techniques in Biochemistry and Microbiology	4
TOTAL		24 (28 -Exit option)

*Student will opt for only one elective course along with respective laboratory course

Student will register for a 4-credit course from MOOCs platform and complete it by the end of 3rd Semester

Semester III

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC301	Bioprocess Technology	4
P2MBTC302	Fundamental of Mycology and Phycology	4
P2MBTC303	Food and Environmental Microbiology	4
P2MBPC304	Fundamental of Bioinformatics and Biostatistics	2
P2MBPC305	Laboratory course in Bioprocess Technology	2
P2MBPC306	Laboratory course in Fundamental of Mycology and Phycology	2
P2MBTE307	Laboratory course in Fundamental of Bioinformatics and Biostatistics	2
	Electives*	
P2MBTE308	Artificial Intelligence in Biology	2
P2MBTE309	Computational Genomics	2
P2MBTE310	Microbiomics	2
P2MBTE311	Lab Course in Artificial Intelligence in Biology	2
P2MBTE312	Lab Course in Computational Genomics	2
P2MBTE313	Lab Course in Microbiomics	2
P2MBMO351	MOOCs Course	
TOTAL		24

*Student will opt for only one elective course along with respective laboratory course

Student will register for a 4-credit course from MOOCs platform and complete it by the end of 3rd Semester

Semester IV

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC401	Immunology and Immunotechnology	4
P2MBTC402	Clinical Microbiology	4
P2MBPC403	Laboratory course in Immunology and Immunotechnology	2
P2MBPC404	Laboratory course in Clinical Microbiology	2
	Electives*	
P2MBTE406	IPRs and Bioethics	2
P2MBTE407	Bio Entrepreneurship	2
P2MBTE408	Research methodology and Scientific communication	2
P2MBTE409	Functional Nutraceuticals	2
P2MBRC410	Research Project	16
TOTAL		30

*Student will opt for only one elective course in Sem IV

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P2MBTC101
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

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:

- Understands the genomic organization of living organisms, study of genes genome, chromosome.
- Aware of molecular mechanism underlying in the process of prokaryotic DNA replication.
- 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

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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

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Credits: 4
Max. Marks: 100
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Minor Test 2: 20
Major Test: 60

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.
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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P2MBTC101
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

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 (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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P2MBTC101
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

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. 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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: Cell Biology
Course code: P2MBTC102
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

COURSE OBJECTIVE:
As cell is the basic unit of life. Therefore, knowledge concerning it is important for the pursuit of other branches in life sciences. The course has been designed to provide insight to students into the structures of cell and constituents, to some extent their functioning, how cells interact along with the cell adhesion and cellular signaling which will serve as the edifice for subsequent learning.

COURSE OUTCOME:
Upon completion of the course students will know
- Introduction about the origins of cells, diversity, structure and function of cell organelles
- Acquainted with sophisticated instruments and their implementation in biological research
- Concept of cell signalling, communication, cell growth, division, cell cycle regulations
- 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

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.

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: Cell Biology
Course code: P2MBTC102 — **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

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

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.

Aging and Senescence: Telomere shortening, mitochondrial dysfunction, Cellular Senescence Mechanisms.

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

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Major Test: 3.0 hours

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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:

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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

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M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2025, Dec. 2026 & Dec. 2027

COURSE TITLE: Cell Biology
Course code: P2MBTC102
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

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. 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.
5. De Robertis, E. D. P., & De Robertis, E. M. F. *Cell and Molecular Biology* – Lippincott Williams & Wilkins, Reprint 2006.
6. Pollard, T. D., & Earnshaw, W. C. *Cell Biology* (3rd Edition) – Elsevier, 2016.
7. Rastogi, S. C. *Cell Biology* – New Age International Publishers, Latest Edition.
8. Verma, P. S., & Agarwal, V. K. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology* – S. Chand Publishing.

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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: P2MBTC103
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

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:

- 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.
- Students get to know about various biochemical processes with a special emphasis on various biomolecules like carbohydrates, Proteins, Lipids and Nucleic acids.
- 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.
- The course aims at priming the students towards understanding deeper concepts of cellular functioning in living systems.
- This course is to Biochemistry yields important insights and practical application in medicine, agriculture, nutrition and industry.

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, aerobic 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

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.

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Course code: P2MBTC103
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Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

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.
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

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

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COURSE TITLE: Biochemistry and Metabolism

Course code: P2MBTC103

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

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:

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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.**

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BOOKS RECOMMENDED :

1. Nelson DL and Cox MM. (2021) Lehninger Principles of Biochemistry, 8th Edition. Macmillan Worth Publishers, New Delhi.
2. Berg JM, Tymoczko, JL and Stryer L, Gregory Gatto (2019) Biochemistry, 9th Edition, WH Freeman & Co., New York.
3. Cohn EE, Stumph PK, Bruening G and Doi RH (1987) Outlines of Biochemistry, 5th Edition, John Wiley & Sons, New York.
4. 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.
5. Voet D, Voet JG and Pratt CW (2016). Fundamentals of Biochemistry, 5th Edition. John Wiley & Sons. New York.

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M.Sc. MICROBIOLOGY

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: P2MBTE107

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

COURSE OBJECTIVE: This course has been designed to develop broad understanding of molecular virological strategies, mechanisms and their relationship to current paradigms in virus pathogenesis. Also, it will provide theoretical knowledge of virus groups which are pathogens, including analyses of emerging infections, through an in-depth study of selected viruses. Study of antiviral activities along with their application and relevance in current research, diagnoses and treatment will remain the main learning objectives of this course.

COURSE OUTCOME:

Upon completing this course,

- Students will understand the classification of viruses, mechanisms of viral infection and replication, pathogenesis and immune response to viral infections,
- Students can apply knowledge of virology to understand viral diseases and control measures, data analysis and interpretation related to viral infections and diseases, and evaluate the role of viruses in human, animal, and plant diseases,
- Students will develop skills in viral detection, genome analysis, vaccine development, and critical thinking.

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 I 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.

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).

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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.
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.

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Course Code: P2MBTE107
Duration of Examinations
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Minor Test2: 1 hour
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Minor Test 1: 20
Minor Test 2: 20
Major Test: 60

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TEST II (after 60days)	21 to 40%	1 hour	10 + 10
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External Practical/ Research (thesis/project/patent) examination

Syllabi for 2 years PG Program as per NEP 2020

M.Sc. MICROBIOLOGY

SEMESTER I

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Duration of Examinations
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Contact hours: 48
Credits: 4
Max. Marks: 100
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Major Test: 60

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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.
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

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M.Sc. MICROBIOLOGY
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: P2MBTE108
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

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

COURSE OUTCOMES: On completion of this course students will be able to
- Perform basic microscopy to cutting-edge sophisticated analytical and imaging tools.
- Will have emphasis on the theoretical underpinnings, practical applications
- Will be acquainted with recent advancements in these dynamic fields.

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.

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

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Duration of Examinations
Minor Test1: 1 hour
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Major Test: 3.0 hours

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

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
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 ans FACS

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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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)

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COURSE TITLE: Analytical techniques in Biology
Course code: P2MBTE108
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

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
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Reference Book

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Major Test: 3.0 hours

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

1. Destin Heilman, Stephen Woski, Donald Voet, Judith G. Voet, Charlotte W. Pratt (2024) Fundamentals of Biochemistry, 6th Edition, Wiley
2. Viswanath Buddolla (2020) Recent Developments in Applied Microbiology and Biochemistry, Academic Press
3. Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors
4. Rodney F.Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques,(2nd ed),Prentice Hall
5. Keith Wilson , John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7th ed) Cambridge University Press
6. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
7. Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer
8. David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology,W.H.Freeman
9. Holme, David J., and Hazel Peck. (1998). *Analytical Biochemistry*. (3rd ed.) Harlow: Pearson Education
10. Segel I.H (1976) Biochemical Calculations (2nd ed),John Wiley and Sons

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SEMESTER I
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COURSE TITLE: Micronutrients and Mammalian Hormones
Course code: P2MBTE109
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

COURSE OBJECTIVES

The course provides knowledge of Minerals, Vitamins and Vertebrate Hormones.

COURSE OUTCOME

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

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

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Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P2MBTE109	**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

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

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.

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P2MBTE109 **Contact hours: 48**
Duration of Examinations **Credits: 4**
Minor Test1: 1 hour **Max. Marks: 100**
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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
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

Syllabi for 2 years PG Program as per NEP 2020
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(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.

Semester II

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC201	Recombinant DNA technology	4
P2MBTC202	Enzyme and enzyme technology	4
P2MBTC203	Fundamentals of Bacteriology and virology	4
P2MBPC204	Laboratory course in Recombinant DNA technology	2
P2MBPC205	Laboratory course in Enzyme and enzyme technology	2
P2MBPC206	Laboratory course in Fundamentals of Bacteriology and Virology	2
	Electives	
P2MBTE207	Applied Biotechnology	4
P2MBTE208	Human diseases biology	4
P2MBTE209	Proteomics and Metabolomics	4
P2MBTE210	Laboratory course in Applied Biotechnology	2
P2MBTE211	Laboratory course in Human diseases and disorders*	2
P2MBTE212	Laboratory course in Proteomics and Metabolomics	2
	Vocational*	
P2MBTV251	Industrial technology	4
P2MBTV252	Diagnostic Techniques in Biochemistry and Microbiology	4
TOTAL		24 (28 -Exit option)

*Student will opt for only one elective course along with respective laboratory course

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SEMESTER II

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

COURSE TITLE: Recombinant DNA technology

Course code: P2MBTC201
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

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

- Genetic engineering and its benefits, Basic principles, the tools and techniques of cloning and gene sequencing.
- Various vectors for transformation, Advantages and limitations of expression vectors, model organism for gene cloning.
- 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.
iv. Southern, Northern and Western blotting; Preparation of labeled DNA probes-radioactive and non- radioactive labeling

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Credits: 4
Max. Marks: 100
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Minor Test 2: 20
Major Test: 60

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

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Course code: P2MBTC201 | **Contact hours: 48**
Duration of Examinations | **Credits: 4**
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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
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.**

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Contact hours: 48
Credits: 4
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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, 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-Blackwell Publishing, UK.
2. Voet, D., Voet, J. G. and Pratt C. W. (2018) Voet's rinciples of Biochemistry. John Wiley & Sons, UK. 6.
3. Andreas Hofmann and Samuel Clokie (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
4. Glick B. R and Patten C. L. (2017) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, USA.
5. Green M. R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual. CSHL Press, USA.
6. Primrose, S. B. and Twyman, R. M. (2006) Principles of Genetic Manipulation and Genomics. Blackwell Publishing, UK.

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER II
Syllabi for the examinations to be held in the years May 2026, May 2027 & May. 2028

COURSE TITLE: Enzyme and Enzyme technology
Course code: P2MBTC202
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

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:
- Able to understand structure, function and mechanism of action of enzymes in living systems
- Able to acquire knowledge on enzyme classes and nomenclature, kinetics, role of enzymes in regulation and metabolism
- 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.

UNIT-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.

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;

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Minor Test 2: 20
Major Test: 60

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.
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).

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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.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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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.
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.

Syllabi for 2 years PG Program as per NEP 2020
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SEMESTER II

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

COURSE TITLE: Fundamentals of bacteriology and virology
Course code: P2MBTC203
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

COURSE OBJECTIVE: A microbiologist must be acquainted did many biological disciplines and with all major groups of micro-organisms. Bacteria and viruses have a great impact on fields such as medicines, agricultural and food sciences, ecology, genetics, bio chemistry and molecular biology. The course on Bacteriology and Virology would provide a balanced introduction of these areas to the students of microbiology.

COURSE OUTCOME:
Upon the completion of the course students will have knowledge about

- Various bacteria, their morphology, ultrastructure, growth and multiplications and their role in the life of other organisms like humans and plants
- Hands on experience on various methods for identification and characterization of bacteria based on cultivation, microscopy, biochemical, molecular and metagenomics approaches.
- Different viruses, their genome, structure and classification, identification of viral diseases (in humans, plants, animals, cyanobacteria, algae, fungi and bacteria), their pathogenesis, symptoms and life cycle of transmission
- Prevention of viral infections using Vaccines and treatment using various antiviral drugs.

UNIT - I: GENERAL BACTERIOLOGY

i. Morphology and ultrastructure of Bacteria and Archaebacteria: capsule and slime layer, antigenic properties of capsule; cell wall: Gram negative and Gram-positive cell wall, L-Forms, cell wall of archaea; plasma membrane of Bacteria and archaea.
ii. Structure, composition and function of flagella, fimbriae, pili, cytoplasm and bacterial cytoskeleton, nucleoid, plasmids, ribosomes, inclusion bodies and microcompartments; Bacterial extracellular vesicles (BEVs).
iii. Bacterial motility and Chemotaxis; Endospore, structure, stages of endospore formation, endospore activation.
iv. Cell division, Binary Fission, Cell Cycle, Chromosome Replication and Partitioning, Cytokinesis, Cytokinesis Without FtsZ

UNIT - II: BACTERIAL GROWTH AND KINETICS

i. Culture media- types and composition. Methods of preservation of microbial cultures.
ii. Growth Kinetics; Batch and Continuous culture, Synchronous and Asynchronous culture.
iii. Growth measurement, Factors affecting growth of bacteria. Control of bacterial growth, Physical, chemical and biological agents.

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iv. Basis of bacterial classification, classification and silent features of bacteria according to the Bergey's manual of determinative and systematic bacteriology

UNIT - III: POLYPHASIC APPROACH OF BACTERIA CLASSIFICATION

i. **Culture based approach**: Isolation & cultivation, cultivation of aerobic and anaerobic bacteria
ii. Bacterial identification: Morphology, microscopy, biochemical characterization and molecular characterization
iii. **Cultivation independent approach**: Metagenomic DNA extraction, gene targeted metagenic approach (Metabarcoding, 16S rRNA, housekeeping genes)
iv. Cloning dependent and cloning independent (Next generation sequencing) metabarcoding approach

UNIT - IV: GENERAL VIROLOGY

i. Discovery, nomenclature, classification of animal and plant viruses, distinctive properties and cultivation of viruses.
ii. Morphology and ultrastructure; Capsid, and their arrangements, Types of envelopes and their composition. Viral genome; types and structure.
iii. Mechanism of viral multiplication, entry, multiplication, synthesis, assembly and release.
iv. Viral metagenomics: Viral particle enrichment, Nucleic acid extraction and sequencing, data analysis, viral diversity and potential functional role.

UNIT - V: TYPES OF VIRUSES

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. Animal Virus: Covid-19, AIDS; Plant viruses: TMV, Cauliflower mosaic virus, Potato mosaic virus.
iv. Viruses of Cyanobacteria, algae and fungi, Virus related agents; viroids and prions

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 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

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.**

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M.Sc. MICROBIOLOGY
SEMESTER II
Syllabi for the examinations to be held in the years May 2026, May 2027 & May. 2028

COURSE TITLE: Fundamentals of bacteriology and virology
Course code: P2MBTC203
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

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. Brock, Biology of Microorganisms, 16th Edition by Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock ©2021 Pearson
2. Microbiology: An Introduction, 13th Edition, Gerard J. Tortora, Bergen Community College; Berdell R. Funke, North Dakota State University; Christine L. Case, Skyline College 13th edition. ©2019 |Pearson
3. Willey, J.M, Sherwood, L.M, and Woolverton, C.J. (2011) Prescott's Microbiology McGraw Hill Eighth International Edition.
4. Saravanan,P. (Virology) 2007 (MJP Pub.)
5. Dimmock N.J., Easton A.J., & Leppard K.N. (2007) (An introduction to modern Virology) Blackwell pub. 5th ed.
6. Cappuccino,J.G and Shreman, N. (2005) Microbiology- A Laboratory Manual Addison Weseley
7. Moat,A.G., Foster, J.W. and Spector, M.K. (2002) Microbial physiology. Wileyliss a John Wiley and sons, Inc. Publication.
8. Pelczar, M.J., Chan, E.C.S.,Kraig N.R., (2002). Microbiology, Mc Graw Hills.
9. Sneath, P.H.A., Elizebeth, S.N.M. (2001) Bergeys manual of systemic Bacteriology.
10. Balows, A.G.Thuper, M. Dworkin. W. Harder, K. Springer Verlag (1991). The Prokaryotes.

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SEMESTER II

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

COURSE TITLE: APPLIED BIOTECHNOLOGY

Course code: P2MBTE207
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 10
Minor Test 1: 20
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:

- Students will be equipped with in-depth knowledge of advanced topics in nanobiotechnology,
- Students will be acquainted with practical understanding of nanobiotechnology, green, white, red, and blue biotechnology
- Students will be focusing on their applications, ethical considerations, and technological innovations.

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

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

COURSE TITLE: APPLIED BIOTECHNOLOGY

Course code: P2MBTE207
Duration of Examinations
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Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 10
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

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 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 the	%Weightage

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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Syllabi for the examinations to be held in the years May 2026, May 2027 & May. 2028

COURSE TITLE: APPLIED BIOTECHNOLOGY

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Minor Test2: 1 hour
Major Test: 3.0 hours

Contact hours: 48
Credits: 4
Max. Marks: 10
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

	covered in the examination	examination	(Marks)
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Total			100
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

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Syllabi for 2 years PG Program as per NEP 2020
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SEMESTER II

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

COURSE TITLE: APPLIED BIOTECHNOLOGY

Course code: P2MBTE207 | **Contact hours: 48**
Duration of Examinations | **Credits: 4**
Minor Test1: 1 hour | **Max. Marks: 10**
Minor Test2: 1 hour | **Minor Test 1: 20**
Major Test: 3.0 hours | **Minor Test 2: 20**
Major Test: 60
Total: 100

to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED:

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

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

COURSE TITLE: APPLIED BIOTECHNOLOGY

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Credits: 4
Max. Marks: 10
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Minor Test 2: 20
Major Test: 60
Total: 100

References

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

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

COURSE TITLE: Human diseases biology

Course code: P2MBTE208	**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

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.

COURSE OUTCOME:

- 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.

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

UNIT 2: 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 anemia and Thalassemia – cause, Pathophysiology, Clinical Features, Diagnosis and treatment
iv. Receptor and transport defects: Cystic fibrosis and familial hypercholesterolemia.

UNIT 3: 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 4: COMPLEX DISORDERS

i. Introduction to multifactorial disorders
ii. Neurodegenerative diseases: Parkinson, Alzheimer's,

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COURSE TITLE: Human diseases biology
Course code: P2MBTE208
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

iii. Mental Illnesses: Schizophrenia, bipolar disorders & depression
iv. Metabolic disorders: CVD, Hyperthyroidism, Obesity.

UNIT 5 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)**
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TEST II (after 60days)	21 to 40%	1 hour	10 + 10
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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:

Syllabi for 2 years PG Program as per NEP 2020
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SEMESTER II

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

COURSE TITLE: Human diseases biology
Course code: P2MBTE208
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

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. 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.

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

COURSE TITLE: Human diseases biology
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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

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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P2MBTE209 **Contact hours:** 48

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

Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
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:

- Students will be able to perform various experimental techniques used in proteomics (e.g., 2D-PAGE, mass spectrometry, protein labeling)
- Students will be able to perform various experimental techniques used in metabolomics (e.g., NMR, GC-MS, LC-MS.
- Students will be able to Analyze proteomics and metabolomics datasets using relevant bioinformatics tools, statistical methods, and pathway analysis software

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
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

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Course code: P2MBTE209 **Contact hours:** 48

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Major Test: 3.0 hours **Minor Test 2: 20**
Major Test: 60
Total:100

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, feed back 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.

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.

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Course code: P2MBTE209 **Contact hours:** 48

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Major Test: 3.0 hours

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COURSE TITLE: Proteomics and Metabolomics

Course code: P2MBTE209

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

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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.

Semester III

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC301	Bioprocess Technology	4
P2MBTC302	Fundamental of Mycology and Phycology	4
P2MBTC303	Food and Environmental Microbiology	4
P2MBPC304	Fundamental of Bioinformatics and Biostatistics	2
P2MBPC305	Laboratory course in Bioprocess Technology	2
P2MBPC306	Laboratory course in Fundamental of Mycology and Phycology	2
P2MBTE307	Laboratory course in Fundamental of Bioinformatics and Biostatistics	2
	Electives*	
P2MBTE308	Artificial Intelligence in Biology	2
P2MBTE309	Computational Genomics	2
P2MBTE310	Microbiomics	2
P2MBTE311	Lab Course in Artificial Intelligence in Biology	2
P2MBTE312	Lab Course in Computational Genomics	2
P2MBTE313	Lab Course in Microbiomics	2
P2MBMO351	MOOCs Course	
TOTAL		24

*Student will opt for only one elective course along with respective laboratory course

Student will register for a 4-credit course from MOOCs platform and complete it by the end of 3rd Semester

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

COURSE TITLE: Bioprocess Technology
Course code: P2MBTC301
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

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:

- 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.
- Able to design bioreactors, formulate and operate scaled-up bioconversion processes
- Able to develop process control systems, instrumentation, and modeling.
- Able to conduct practice-based tasks related to bioprocessing in a responsible, safe, voluntary, self-motivated.

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.

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

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Major Test: 3.0 hours

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

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.
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)
TEST I (after 30 days)	20%	1 hour	10 + 10

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

COURSE TITLE: Bioprocess Technology
Course code: P2MBTC301
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

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

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

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

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

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. 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.

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

COURSE TITLE: Fundamentals of Mycology and Phycology
Course code: P2MBTC302
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

COURSE OBJECTIVE: The course on fungi and algae has been designed for the students who need an orderly presentation of certain fundamental facts on the structure and classification of fungi and algae. With the recent studies in the genetics and the biochemistry of fungi, and with the realization of the economic and ecological importance, the need for such a course is envisaged.

COURSE OUTCOME:
In the end of the course, the student should be able to:-
- Outline the higher taxonomy of fungi and algae
- Discuss the characteristics of the major classes and orders within fungi and algae
- Discuss the importance of fungi and algae in various ecological niches.

UNIT- I: INTRODUCTION TO FUNGI

i. Introduction of fungi, Occurrence and distribution, Somatic structure, Nutrition, Reproduction in fungi
ii. Important systems of fungal classification: (Alexopoulos, Ainsworth, Alexopoulos and mims); Modern method of classification
iii. Mastigomycetes: Characteristic features; Thallus organisation; reproduction; Life cycle with reference to Synchytrium, Rhizopus, Phytopathora
iv. Zygomycetes: General characteristics; Life cycle and classification with reference to Rhizopus and Mucor.

UNIT - II: HIGHER FUNGI

i. Ascomycetes: Hemiascomycetes (Saccharomyces), Plectomycetes (Penicillium), Pyrenomycetes (Neurospora)
ii. Discomycetes (Peziza), Laboulbeniomycetes, Loculoascomycetes
iii. Basidiomycetes: Hymenomycetes (Agaricus), Gasteromycetes (Cyathus), Teliomycetes (Puccinia)
iv. Deuteromycetes: Blastomycetes, Coelomycetes, Hyphomycetes

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

UNIT - IV: FUNGI AND ECOSYSTEM

i. Mycorrhiza: Occurrence, Structure, Types and Importance.
ii. Economic importance of fungi; Fungi as food: Mushrooms, Nutritional and medicinal value of edible mushrooms; Fungal protein (Yeast and Fusarium)
iii. Making mutants and analyzing genetic interactions in yeast, mating type switches in yeast
iv. Fungi in Agriculture and Forestry: Fungi as plant parasites, bio-fertilizers and biopesticides

UNIT - V: ALGAE

i. Introduction of algae: Distinctive characteristics of algae, Diversity of habitat, thallus organization and cell ultrastructure
ii. Reproduction in algae and types of life cycles, Nutrition in algae
iii. General characters and systems of classification of algae
iv. Brief account of Chlorophyta, Bacillariophyta; Phaeophyta; Rhodophyta; Modern concept of algal classification

UNIT - V: ALGAE AND ECOSYSTEM

i. Economic importance of algae: Algae as Food and Feed, Role of algae in industry (Alginic acid, Agar, Carrageenan)
ii. Algal biofertilizers, Biodiesel and hydrogen production by algae
iii. Algal ecology, Algal blooms, Eutrophication, Algal indicators
iv. Lichens: Occurrence, Structure, Types and Importance

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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Minor Test1: 1 hour
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Contact hours: 48
Credits: 4
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

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

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

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Major Test: 3.0 hours

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

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. Michael J. Pelczar JR, E.C. S.Chan, Noel R. Krieg. (2021) Microbiology. Mc Graw Hills
2. Mehrotra, R.S. and K.R. Aneja (2015), An introduction to Mycology, New Age International publishers.
3. Goodman P (2022) Introduction to Mycology. State Academic Press (1st edition).
4. Alexopoulos, C.J. and C.W. Mims (2007), Introduction to Mycology. Wiley Eastern Ltd. New Delhi. (4th ed.).
5. Subbalis, G. (2004) The Fungi. Narosa Publishing House, N.Delhi.
6. Stainer, R.Y., Ingrahm, J.L., Wheelis, M.L. and Painter, P.R. (1991) General Microbiology. The MacMillian Press.
7. Lee R. E. (2018) Phycology. The Cambridge University Press (5th Edition)
8. Madigan, M.T.,Martinko, J.M. and Parker, J. (2008). Brock Biology of microorganisms (14 th ed.)
9. Cappuccino, J.G. and Shreman, N. (2005) Microbiology: - A Laboratory Manual. Addison Wiley.
10. Tortora, G.J., Funke, B.R. and Case (2008) Microbiology: An introduction 9th ed. Ed., Benzamin Cummings.

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

COURSE TITLE: Fundamentals of Mycology and Phycology

Course code: P2MBTC302

Duration of Examinations

Minor Test1: 1 hour

Minor Test2: 1 hour

Major Test: 3.0 hours

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Credits: 4

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Minor Test 2: 20

Major Test: 60

Total: 100

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

Course title: FOOD AND ENVIRONMENTAL MICROBIOLOGY
Course code: P2MBTC303
Duration of Examinations
Minor Test 1: 1 hour
Minor Test 2: 1 hour
Major Test: 3 hours

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

COURSE OBJECTIVES: The aim of the course is to introduce the students to the growing environmental problems due to ever increasing industrialization and civilization and how the microbes can play vital role in circumventing some of the problems. While microorganisms are increasingly being used for food production or augmentation, these are also responsible for food spoilage and considerable losses. Huge inputs are required to preserve the foods against microbial invasion and above all these are major cause of the most horrible diseases outbreaks

COURSE OUTCOME:
- Discuss microbiology of different environmental habitats like soil, water, air and food
- Outline the methods to analyze air, water and food quality and how microbes cause diseases.
- Discuss different types of waste and the role of microbes in solid and liquid waste management.
- Discuss the role of microbes in biodegradation, biodeterioration and bioremediation of major environmental pollutants.
- Discuss the role of microbes in food preservation, fermentation and spoilage.

UNIT-I: INTRODUCTION TO FOOD AND ENVIRONMENTAL MICROBIOLOGY

i. Food Microbiology: food as a substrate for microorganisms, microorganisms important in food microbiology, Factors affecting the growth and survival of microorganism in food: intrinsic and extrinsic factors.
ii. Aerobiology: dispersal of airborne microorganisms, droplet nuclei, aerosol; Assessment of air quality; Air borne disease caused by bacteria, fungi, virus -their symptoms and preventive measures.
i. Water ecosystems: types, fresh water, marine habitats, Water zonation, upwelling, eutrophication and potability of water and microbial assessment of water quality. Brief account of water borne diseases and preventive measure
ii. Soil Microbiology: classification of soil-physical and chemical characteristics, soil as a habitat for micro-organisms, microflora of various soil types, Plant-microbe interactions, Major biogeochemical cycles and microorganisms: carbon, nitrogen, Phosphorous and Sulphur cycle

UNIT-II: FOOD PRESERVATION AND FERMENTATION

i. Food Preservation: General characteristics, importance and its principles, Methods of food preservation: asepsis, removal of microorganisms, anaerobic conditions, drying, irradiation.

GD

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Course code: P2MBTC303	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test 1: 1 hour	**Max. Marks: 100**
Minor Test 2: 1 hour	**Minor Test1: 20**
Major Test: 3 hours	**Minor Test2: 20**
	Major Test: 60

ii. Preservation using high and low temperatures, chemical preservatives and food additives
iii. Microbiology of meat, vegetable and cereal products (Vinegar, wine, Sauerkraut, Pickles)
iv. Microbiology of fermented milk (cheese, yogurt), Probiotics, prebiotics, and synbiotics

UNIT - III: FOOD SPOILAGE AND FOOD SAFETY

i. Food spoilage: general principle underlying food spoilage and contamination, classification of foods by ease of spoilage, factors affecting spoilage, chemical changes caused by microorganisms.
ii. Spoilage of canned and fermented foods and dairy products
iii. HACCP concept for foods production and its principle, importance and application of HACCP concept
iv. Hurdle technology, Common hurdle in food processing, importance and application of Hurdle technology

UNIT - IV: FOOD BORNE INFECTIONS AND INTOXICATIONS

i. Food borne infections and intoxication: Bacterial and non-bacterial - *Brucella, Bacillus cereus, Clostridium botulism, Escherichia, Salmonella, Shigella, Yersinia*.
ii. Nematodes, algae, fungi and viruses in food borne infection and intoxications.
iii. Food borne outbreaks- laboratory testing; prevention measures- food sanitation in manufacture and retailing. Microbial diagnostics in food.
iv. Food control agencies their rules and regulations, plant sanitation- worker's health standards, quality control, waste disposal

UNIT-V: ENVIRONMENTAL WASTE TREATMENT, BIODEGRADATION AND BIODETERIORATION

i. Waste -types (solid, Liquid) and characterization of wastes; Waste treatment; Primary secondary and tertiary treatments. Physical, chemical and biological treatment of wastes, activated sludge, oxidation ponds.
ii. Solid waste treatment-saccharification, gasification, composting, effluent treatment, BOD, COD; Utilization of solid waste-food, fuel (ethanol, methane), fertilizer (composting).
iii. Biodegradation of recalcitrant compounds. Bioaccumulation of metals and detoxification, biopesticides. Biodeterioration of paper, leather, wood, textile- modes of deterioration and organisms involved.

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Course title: FOOD AND ENVIRONMENTAL MICROBIOLOGY
Course code: P2MBTC303 — **Contact hours: 48**
Duration of Examinations — **Credits: 4**
Minor Test 1: 1 hour — **Max. Marks: 100**
Minor Test 2: 1 hour — **Minor Test1: 20**
Major Test: 3 hours — **Minor Test2: 20**
Major Test: 60

iv. Bioremediation of contaminated soils and wastelands; Microbial services in greenhouse gases mitigation, Impact of Genetically modified organisms on environment

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)
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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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Syllabi for 2 years PG Program as per NEP 2020
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Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

Course title: FOOD AND ENVIRONMENTAL MICROBIOLOGY

Course code: P2MBTC303	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test 1: 1 hour	**Max. Marks: 100**
Minor Test 2: 1 hour	**Minor Test1: 20**
Major Test: 3 hours	**Minor Test2: 20**
	Major Test: 60

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. Pepper, I. L., Gerba, C., Brusseau, M. L. (2019). Environmental and Pollution Science. Netherlands: Elsevier Science
2. Ramesh, K. V. (2019). Environmental Microbiology. India: MJP Publishers.
3. Baker, K.H. and Herson, D.S. (1994) Bioremediation. McGraw Hill Inc., New York.
4. Bagyaraj and Rangasamy (2009) Agricultural Microbiology. PHI learning.
5. Martin Alexander (1999) Biodegradation and Biodeterioration. Academic Press.

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M.Sc. MICROBIOLOGY

SEMESTER III

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

Course Title: FUNDAMENTALS OF BIOINFORMATICS AND BIOSTATISTICS

Course Code: P2MBPC304
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 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

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:

- Gain broad understanding in Statistics and develop an understanding of basic theory of computational tools
- Recognize importance and value of statistical thinking, training, and approach to problem solving on a diverse variety of Biology
- Gain working knowledge of computational tools and methods and how to use them to critically analyse and interpret results of any study.
- Describe the contents and properties of most important bioinformatics databases

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, 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.

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

Course Title: FUNDAMENTALS OF BIOINFORMATICS AND BIOSTATISTICS

Course Code: P2MB[illegible]304
Duration of Examinations
Minor Test1: 1 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
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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

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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER III
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

Course Title: FUNDAMENTALS OF BIOINFORMATICS AND BIOSTATISTICS

Course Code: P2MBPC304
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 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

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	05+ 05
TEST II (after 60days)	21 to 40%	1 hour	05+ 05
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	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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER III
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Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
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Major Test: 30

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.
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.
1. Attwood, T.K. and Parry- Smith, D.J. (1999) Introduction to bioinformatics. Pearson Education, Singapore.
2. Curtin, D.P. et. al., (1999). Information technology. Tata McGraw-Hill Publishing Company, New Delhi.
3. Dhar M.K. and Kaul, S (1997) Statistics in Biology. Malhotra Brothers, Jammu.

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER III
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: Artificial Intelligence in Biology
Course code: P2MBTE308
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 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

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
- Student will be able to understand the basic concepts, history, and foundations of Artificial Intelligence and its applications in various domains.
- Students having knowledge and skills to apply artificial intelligence (AI) techniques will be able to solve complex problems and drive innovation in biology.
- Students will be able to think critically and creatively to develop basic AI tools that address real-world biological challenges.

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

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

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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. IV. Agricultural and environment: Crop yield prediction; Disease and pest detection; Resource optimization (e.g., water, fertilizers); Environmental monitoring and sustainability. Ethical principles and bias in AI applications for biology

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TEST II (after 60days)	21 to 40%	1 hour	10
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

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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

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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
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

Syllabi for 2 years PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER III

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

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P2MBTE309
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5hours

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

COURSE OBJECTIVE:

This course aims to provide students with a comprehensive understanding of genomics, transcriptomics, epigenomics, focusing on the structure, function, and evolution of genomes. Students will learn the principles and methods used in DNA sequencing, bioinformatics analysis. Through lectures, case studies, and hands-on analysis, students will develop the skills to critically evaluate scientific literature and conduct basic genomic data analysis.

COURSE OBJECTIVE:

- This course will make student understand the fundamental concepts of genomics, sequence analysis, and genome organization, including structural and functional genomics.
- Students will be able to apply computational tools and algorithms for genome assembly, annotation, and comparative genomics.
- Student can critically assess scientific literature in computational genomics and communicate results effectively using appropriate bioinformatics tools and visualization methods.

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

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Consensus (OLC); Assembly statistics: N50, L50, genome coverage, Genome completeness estimation, Contigs, Scaffolds, Pseudochromosome and Chromosome

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, TWAS.

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 remodeling, 3D Chromatin, ChIP-seq, 5C, 4C, 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

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

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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

Syllabi for 2 years PG Program as per NEP 2020
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SEMESTER III

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

COURSE TITLE: MICROBIOMICS

Course code: P2MBTE310
Duration of Examinations
Minor Test1: 1 hour
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Credits: 2
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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.

COURSE OUTCOME:

- Students with a comprehensive understanding of microbiomics can explore the composition and role of microbial communities in health, disease, and the environment.
- Students will be able to design microbiome-based studies and interpret complex multi-omics data (e.g., metagenomics, metabolomics, metaproteomics) for systems-level understanding

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

COURSE TITLE: MICROBIOMICS

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Duration of Examinations
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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 GENOMES 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

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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
4. Muniyandi Nagarajan (2024) Metagenomics: Perspectives, Methods, and Applications, Elsevier Science ISBN: 9780323916318, 0323916317

Semester IV

COURSE CODE	PAPER	CREDITS
	Core Courses	
P2MBTC401	Immunology and Immunotechnology	4
P2MBTC402	Clinical Microbiology	4
P2MBPC403	Laboratory course in Immunology and Immunotechnology	2
P2MBPC404	Laboratory course in Clinical Microbiology	2
	Electives*	
P2MBTE406	IPRs and Bioethics	2
P2MBTE407	Bio Entrepreneurship	2
P2MBTE408	Research methodology and Scientific communication	2
P2MBTE409	Functional Nutraceuticals	2
P2MBRC410	Research Project	16
TOTAL		30

*Student will opt for only one elective course in Sem IV

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

COURSE TITLE: Immunology and Immunotechnology
Course code: P2MBTC401
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

COURSE OBJECTIVES: This course introduces students to molecular and cellular immunology, including antigen and antibody structure and function, major histocompatibility 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 OBJECTIVES
By the end of this course, students should be able to:

- Understand fundamental concepts of human immune system and immunology and their role in in both maintaining health and contributing to disease.
- Identify the cellular and molecular basis of immune responsiveness.
- Distinguish various cell types involved in immune responses and associated functions
- Differentiate and understand immune responses in relation to infection and vaccination
- Demonstrate knowledge and practice of common immunological laboratory procedures used to detect and measure the immune response
- 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
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,

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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.

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

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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

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

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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
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,H. (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.

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COURSE TITLE: CLINICAL MICROBIOLOGY
Course code: P2MBTC402
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

COURSE OBJECTIVES: We are in contact of myriad of organisms in the environment and also with an enormous number that inhabit out bodies. Human kind has long been beset by diseases that may spread with devastating effects. The study in medical microbiology has practical benefits by an understanding to explore the cause and control of these diseases.

COURSE OUTCOME:
- The student will be able to identify common infectious agents and the diseases that they cause.
- The student will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
- The student will be able to explain general and specific mechanisms by which an infectious agent causes disease.
- The student will be able to assess treatment strategies including the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.
- The student will be able to explain interventions employed to prevent infectious diseases including infection control measure and vaccines

UNIT - I: PRINCIPLES OF CLINICAL MICROBIOLOGY

i. Early discovery of pathogenic microorganisms; development of bacteriology as scientific discipline; contribution made by eminent scientists; Classification of medically important microorganisms
ii. Normal microbial flora of human body; role of the resident flora; normal flora and the human host.
iii. Opportunistic pathogens and true pathogens. Exogenous infection, mode of spread of infection.

Fungal diseases caused by Dermatophytes, Dimorphic fungi and Opportunistic fungal pathogens.

UNIT - II: MECHANISMS OF BACTERIAL AND VIRAL PATHOGENESIS

i. Microbial pathogenicity; transmission, infectivity and virulence.
ii. Establishment, spreading: invasiveness, tissue damage: Toxigenicity and anti-phagocytic factors.

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iii. Mechanism of bacterial adhesion, colonization and invasion of mucous membrane of respiratory, enteric and urogenital tracts. Role of aggressins, coagulase, fibrinolysin or kinase, Depolymerizing enzymes
iv. Virus–Host Interactions and Host response to viral infection, Host immune responses to virus infections and evasion of Immune Responses by Viruses

UNIT - III: MICROBIAL AGENTS OF BACTERIAL AND PROTOZOAN DISEASES

i. Bacterial diseases caused by *Staphylococcus, Streptococcus, Neisseria.*
ii. Bacterial diseases caused by *Corynebacterium, Bacillus, Clostridium,*
iii. Bacterial diseases caused by *Klebsiella, Enterobacter, Haemophylius, Mycobacterium,* and *Treponema*
iv. Protozoan diseases caused by *Plasmodium, Giardia, Entamoeba*

UNIT - IV: MICROBIAL AGENTS OF VIRAL DISEASES

i. Pox viruses, Herpes viruses, Adenoviruses, Arboviruses
ii. SARS Viruses, Picorna viruses, Orthomyxoviruses, Paramyxovirus
iii. Rhabdoviruses, Rotavirus, Hepatitis viruses
iv. Oncogenic viruses, Retrovirus, Human Immunodeficiency Virus

UNIT - V: LABORATORY DIAGNOSIS AND CONTROL IN INFECTIOUS DISEASES

i. Overview of laboratory diagnostics – Conventional and New methods (Molecular and Immunological methods)
ii. Laboratory control of antimicrobial therapy: various methods of drug susceptibility testing, antibiotic assay in body fluids.
iii. Brief account of available vaccines, types and schedules, passive prophylactic measures; Antivirals, Antiretrovirals, Modern approaches of virus control: Anti-sense RNA, siRNA, ribozymes.
iv. Noscomial infection, common types of hospital infections: their diagnosis and control.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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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

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Major Test

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Minor Test 1: 20
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Major Test: 60

Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

BOOKS RECOMMENDED

- Tille P (2021). Bailey and Scott's Diagnostic Microbiology.
- Ananthanarayan, R and Jayaram, C.K, (2020) Textbook of microbiology. Orient longman.
- Murray PR, Rosenthal KS, Pfaller MA (2020) Medical Microbiology. Elsevier
- Engelkirk, PG, Engelkirk, JD, Fader RC (2020). Burtons Microbiology for Health Sciences. Jones and Bartletts learning
- Livingstone, Churchill. (1996) vol. I Microbial infection. Mackie and McCartney.
- Livingstone, Churchill. (1996) vol.II Practical Medical microbiology, Mackie and McCartney.
- Jawetz Melnick & Adelbergs Medical Microbiology, 27th Edition. Geo. Brooks, Karen C. Carroll, Janet Butel and Stephen Morse Copyright © 2016 by McGraw-Hill Education.
- Shanson, D.C. Wright, P.S.G. (1995) Microbiology in clinical practice.

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SEMESTER IV
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Course Title: IPRs and Bioethics
Course code: P2MBTE406
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5hours

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

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:

- 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.
- Students will able to analyze the effects of intellectual property rights on society as a whole.
- Students will able to understand different aspects of bioethical issues arises due to advancement in Microbiology.
- This course encourages students to take up entrepreneur opportunities in the areas of Microbiology/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: PATENT

i. Specific challenges in biological patenting: gene patents, diagnostic patents, and biopharmaceuticals.
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
iv. Patent Licensing; Technology Transfer; The role of technology transfer offices in academic and research institutions; Patent Infringement

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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

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TEST I (after 30 days)	20%	1 hour	10
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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	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

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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.**

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BOOKS RECOMMENDED:

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
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

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COURSE TITLE: Bioentrepreneurship

Course code: P2MBTE407 | **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

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:

- The course will provide the concept of enterprise, generating ideas, financial and legal issues of entrepreneurship in biotechnology-based industries (agri/pharma).
- This course encourages students to take up entrepreneur opportunities in the areas of Microbiology/Biotechnology.

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
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 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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, segments; 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, Technology transfer, Quality control. Regulatory Compliances and procedures

COURSE TITLE: Bioentrepreneurship
Course code: P2MBTE407
Duration of Examinations
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Major Test: 2.5 hours

Contact hours: 24
Credits: 2
Max. Marks: 50
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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; Government grants Schemes like SISFS, CGSS, AIM etc., BIRAC: SEED fund, BIG etc.
iv. Startups/companies working in different areas of specialization (agri-based, pharma -based etc.); Case studies of successful biotech startups

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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. Gupta A, George G, Fewer TJ; (2024) Venture Meets Mission: Aligning People, Purpose, and Profit to Innovate and Transform Society, Stanford Business Books.
2. Bhatt AK, Bhatia RK, Bhalla TC; (2023) Basic Biotechniques for Bioprocess and Bioentrepreneurship, Academic Press Inc.
3. Craig S; (2020) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Academic Press (Elsevier), UK.
4. Ahmetoglu et al., (2017) The Wiley handbook of entrepreneurship, John Wiley and sons.
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. Shimasaki C; (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Academic Press.
8. Patzelt, H, Brenner T; (2008) Handbook of Bioentrepreneurship, Springer Publications.

Additional Resources:

-Webinars and Guest Lectures: Regular sessions from biotech entrepreneurs and investors sharing industry insights.

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COURSE TITLE: Bioentrepreneurship

Course code: P2MBTE407
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 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

-**Industry Networking**: Opportunities to engage with biotech incubators, accelerators, and funding bodies.

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COURSE TITLE: Research Methodology and Scientific Communication

Course code: P2MBTE408	**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 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:

By the end of this course:

- Understand the various types of tools and techniques used in scientific communications.
- Students will know the various components of research papers.
- Students will know how to do plagiarism check using various plagiarism software like Urkund, Turnitin etc.
- Students will know about the various ethical issues associated scientific writing and communication.

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;
ii. Initiating communication; preparing and presenting using PowerPoint; defending interrogation; 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;

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Course code: P2MBTE408 | **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

ii. Problems while writing a scientific document; 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; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

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%	4 hours	25
External Examination	100%	4 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

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COURSE TITLE: Research Methodology and Scientific Communication

Course code: P2MBTE408	**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

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. 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.
6. Mohan, K., & Singh, N. P. (2010). Speaking English Effectively. Delhi: Macmillan India.
7. Movie: Naturally Obsessed, The Making of a Scientist

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Course code: P2MBTE408
Duration of Examinations
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Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 24
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Max. Marks: 50
Minor Test 1: 10
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Total:50

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COURSE TITLE: Functional Nutraceuticals
Course code: P2MBTE409
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 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

COURSE OBJECTIVE:
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.

COURSE OUTCOMES:
- Students will gain insights into the biochemical basis of nutrient metabolism
- Students will get acquainted with the role of nutrition in health, disease prevention, and therapeutic strategies.
- Students will gain knowledge about food safety regulations and licensing

UNIT I: 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 II: HORMONAL AND MOLECULAR REGULATION OF METABOLISM AND EATING BEHAVIOUR

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.

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iv) Clinical biomarkers of nutritional status (serum proteins, lipid profile, vitamin levels), Biochemical basis of malnutrition and overnutrition.

UNIT III: 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.

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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.

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Contact hours: 24
Credits: 2
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Minor Test 1: 10
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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.
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.

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COURSE TITLE: Research Project
Course code: P2MBTE410 **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

- Apply academic concepts and theoretical knowledge to address real-world problems.
- Demonstrate research competencies, including literature review, data collection, data analysis, and interpretation of results.
- Draw meaningful conclusions from research findings and present them effectively.
- Communicate research outcomes clearly in written, oral, and visual formats.
- Collaborate effectively in teams, demonstrating strong interpersonal and time management skills.
- 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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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:
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:

COURSE TITLE: Research Project
Course code: P2MBTE410 **Contact hours: 192**
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Dissertation: 200
Presentation and Viva: 200

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.
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

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Max. Marks: 400
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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).

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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: .....

10E

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Course code: P2MBTE410 **Contact hours: 192**
Duration of Examinations **Credits: 16**
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Dissertation: 200
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