UNIVERSITY OF JAMMU

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

Academic Section
Email: academicsectionju14@gmail.com

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

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Biotechnology** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

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

One Year Post Graduate Programme under NEP-2020

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

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

Sd/-
DEAN ACADEMIC AFFAIRS

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

Copy for information and necessary action to:

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

10/10/25
Joint Registrar (Academic)

9/10/25 9/10/25

M.Sc. Biotechnology 1 year programme as per NEP 2020

School of Biotechnology, University of Jammu

Syllabi framework for 1 year PG Programme in Biotechnology

S. no	Course no.	Course title	No of credits	Credit level	Credit point	Course type	Marks		Nature of course				Swayam /MOOC	Vocational Course	Research project/summer internship/ Dissertation
						Core/ elective/any other	Theory	Practical	Global	National	Regional	skill			
1	P1BTTC101	Bioprocess Technology	4	6.5	26	core	100		✓	✓	✓	✓			
2	P1BTTC102	Fundamentals of Genetics and Genomics	4	6.5	26	core	100		✓	✓	✓				
3	P1BTTC103	Basic Environmental Biotechnology	4	6.5	26	core	100		✓	✓	✓				
4	P1BTTC104	Fundamentals of Biostatistics and Bioinformatics	2	6.5	13	core	50		✓	✓	✓	✓			
5	P1BTPC105	Laboratory course based on Bioprocess Engineering	2	6.5	13	core		50	✓	✓	✓	✓			
6	P1BTPC106	Laboratory course based on fundamentals of Genetics and Genomics	2	6.5	13	core		50	✓	✓	✓	✓			
7	P1BTPC107	Laboratory course based on Fundamentals of Biostatistics and Bioinformatics	2	6.5	13	core		50	✓	✓	✓	✓			
8	P1BTTE108	Artificial Intelligence in Biology	2	6.5	13	Elective	50		✓	✓	✓	✓			
9	P1BTTE109	Computational Genomics	2	6.5	13	Elective	50		✓	✓	✓	✓			
10	P1BTTE110	Microbiomics	2	6.5	13	Elective	50		✓	✓	✓	✓			
11	P1BTPE111	Laboratory course based on Artificail intelligence in Biology	2	6.5	13	Elective		50	✓	✓	✓	✓			
12	P1BTPE112	Laboratory course based on Computational Genomics	2	6.5	13	Elective		50	✓	✓	✓	✓			
13	P1BTPE113	Laboratory course based on Microbiomics	2	6.5	13	Elective		50	✓	✓	✓	✓			
14	P1BTT1201	Immunology and Immunotechnology	4	6.5	26	core	100		✓	✓	✓	✓			
15	P1BTTC202	Fundamentals of Plant Biotechnology	2	6.5	26	core	100		✓	✓	✓	✓			
16	P1BTTC303	Applied Animal Biotechnology	2	6.5	13	core	50		✓	✓	✓	✓			
17	P1BTPC205	Laboratory course based on Immunology and Immunotechnology	2	6.5	13	core		50	✓	✓	✓	✓			
18	P1BTPC206	Laboratory course based on Fundamentals of Plant Biotechnology and Applied Animal Biotechnology	2	6.5	13	core		50	✓	✓	✓	✓			
19	P1BTTE207	Bioentrepreneurship	2	6.5	13	Elective	50		✓	✓	✓	✓			
20	P1BTTE208	IPRs and Bioethics	2	6.5	13	Elective	50		✓	✓	✓	✓			
21	P1BTTE209	Research Methodology and Scientific Communication	2	6.5	13	Elective	50		✓	✓	✓	✓			
22	P1BTTE210	Functional Nutracetutical	2	6.5	13	Elective	50		✓	✓	✓	✓			
23	P1BTRC211	Research Project	08	6.5	104	core		400	✓	✓	✓	✓			✓

Syllabus for the PG Programme (1 years) as per NEP-2020

Total Credits: 52

SEMESTER I SCHEME

COURSE CODE	PAPER	CREDITS
	Core Courses	
P1BTTC101	Bioprocess Technology	4
P1BTTC102	Fundamentals of Genetics and Genomics	4
P1BTTC103	Basic Environmental Biotechnology	4
P1BTTC104	Fundamentals of Biostatistics and Bioinformatics	2
P1BTPC105	Laboratory course based on Bioprocess Engineering	2
P1BTPC106	Laboratory course based on fundamentals of Genetics and Genomics	2
P1BTPC107	Laboratory course based on Fundamentals of Biostatistics and Bioinformatics	2
	Electives*	
P1BTTE108	Artificial Intelligence in Biology	2
P1BTTE109	Computational Genomics	2
P1BTTE110	Microbiomics	2
P1BTPE111	Laboratory course based on Artificial intelligence in Biology	2
P1BTPE112	Laboratory course based on Computational Genomics	2
P1BTPE113	Laboratory course based on Microbiomics	2
TOTAL		24

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

Syllabus for the PG Programme (1 years) as per NEP-2020

SEMESTER II SCHEME

COURSE CODE	PAPER	CREDITS
Core Courses		
P1BTTC201	Immunology and Immunotechnology	**4**
P1BTTC202	Fundamentals of Plant Biotechnology	**2**
P1BTTC203	Applied Animal Biotechnology	**2**
P1BTPC205	Laboratory course based on Immunology and Immunotechnology	**2**
P1BTPC206	Laboratory course based on Fundamentals of Plant Biotechnology and Applied Animal Biotechnology	**2**
Electives*		
P1BTTE207	Bioentrepreneurship	**2**
P1BTTE208	IPRs and Bioethics	**2**
P1BTTE209	Research Methodology and Scientific Communication	**2**
P1BTTE210	Functional Nutraceuticals	**2**
Research (thesis/project/patent)		
P1BTRC211	Research Project	**16**
TOTAL		**30**

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: BIOPROCESS TECHNOLOGY

Course code: P1BTTC101
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

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

Course objective: This course is to introduce students to the engineering aspects of microbial processes and help them to develop understanding of design, operation and optimization of bioprocess systems for production of products of industrial significance.

Course Outcome:

After completion of the course the students are:

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

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

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

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

UNIT - I: OVERVIEW OF BIOPROCESSING

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: BIOPROCESS TECHNOLOGY

Course code: P1BTTC101
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

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

UNIT-II: BIOREACTORS, BIOPROCESS MONITORING AND CONTROL

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

UNIT-III: BIOPROCESS BASED INDUSTRIAL PROUDCTS

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

UNIT-IV: DOWNSTREAM PROCESSING AND EFFLUENT TREATMENT

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: BIOPROCESS TECHNOLOGY

Course code: P1BTTC101
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

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

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
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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: BIOPROCESS TECHNOLOGY

Course code: P1BTTC101 | **Contact hours**: 48

Duration of Examinations | **Credits**: 4

Minor Test: 1 hour | **Max. Marks**: 100

Minor Test: 1 hours | **Minor Test 1**: 20

Major Test: 3 Hours | **Minor Test 2:** 20

Major Test: 60

Total: 100

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: BIOPROCESS TECHNOLOGY

Course code: P1BTTC101
Duration of Examinations
Minor Test: 1 hour
Minor Test: 1 hours
Major Test: 3 Hours

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

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.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology
SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF GENETICS AND GENOMICS

Course code: P1BTTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

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

Course Outcome:

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

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

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

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

UNIT-I: GENETICS-I

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

UNIT-II: GENETICS-II

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology
SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF GENETICS AND GENOMICS

Course code: P1BTTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

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

UNIT- III: GENETICS-III

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

UNIT- IV: GENOMICS I

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

UNIT- V: GENOMICS II

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF GENETICS AND GENOMICS

Course code: P1BTTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

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.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology
SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF GENETICS AND GENOMICS

Course code: P1BTTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

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

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

M.Sc. Biotechnology

SEMESTER-IV

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

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P1BTTC103
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

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

Course Outcome:

Upon the completion of the course students will have knowledge about

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

CO2: Conventional and non-conventional sources of energy

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

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

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

UNIT- I: ENVIRONMENTAL BIOLOGY

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

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

M.Sc. Biotechnology

SEMESTER-IV

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

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P1BTTC103
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

UNIT- II: NATURAL ENVIRONMENTAL BIOTECHNOLOGY

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

UNIT – III: GLOBAL ENVIRONMENTAL ISSUES

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

UNIT-IV: SOLID WASTE MANAGEMENT

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

UNIT-V: BIOREMEDIATION AND BIODEGRADATION

i. Bioremediation: principle, concept and process.

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

M.Sc. Biotechnology

SEMESTER-IV

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

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P1BTTC103
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

ii. Bioremediation of contaminated soils and waste land, Spilled Hydrocarbons, Phytoremeditation.
iii. Biodegradation of Organic pollutants, Pesticides and Xenobiotics. Biopesticides and Integrated Pest management.
iv. Biopollution, Biopolymers, Bioplastics and Biomining

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

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

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays**

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

M.Sc. Biotechnology

SEMESTER-IV

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

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P1BTTC103
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

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.**

BOOKS RECOMMENDED

1. Rathoure, A.K. (2021) Industrial and Environmental Biotechnology. Horizon. Discovery Pub house.
2. De, A. K. (2018) Environmental Chemistry. 9th edition. Wiley Eastern Ltd. New Delhi
3. Moo-Young, M. (2011) Comprehensive Biotechnology, Pergamon Press, Oxford.
4. Arora, N. K., Sobti, R. C., Kothari, R. (2019) Environmental Biotechnology for Sustainable future. Springer Singapore
5. Metcalf L et al. (2010) Tchobanoglous, G., Franklin, B. and Stensel, H. D. (1991) Wastewater Engineering – Treatment, Disposal and Reuse, Tata McGraw Hill, New Delhi.
6. Allsopp, D. and Seal, K. J. (2010) Introduction to Biodeterioration, ELBS/Edward Arnold,
7. Kumar, A. (2004) Environmental Biotechnology. Daya publishing house.
8. Goel P.K. and Pathade G.R. (2004) Biotechnological applications in Environment and Agriculture. ABD Publishers.
9. Goel, P.K. (2003) Advances in industrial waste water treatment. ABD Publishers.
10. Cutter, S. L. (2003) Environmental risks and Hazards. Prentice Hall.
11. Ignacimuthu, S. (2003) Environmental Science. Phoenix Publishing house.

Course Title: BASIC ENVIRONMENTAL BIOTECHNOLOGY

Course code: P1BTTC103
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hours
Major Test: 3 hours

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

12. Pathade, G. R. and Goel, P.K. (2003) Biotechnology in Environmental Management. ABD Publications.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P1BTTC104
Credit: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

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

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

Course outcome:

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

CO1: Gain broad understanding in Statistics

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

CO3: Develop an understanding of basic theory of computational tools

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

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

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

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

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

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

UNIT I: STATISTICAL METHODS AND INFERENCE

i. **Descriptive Statistics and Probability Fundamentals-** Measures of central tendency: Mean, median, and mode; Measures of dispersion: Range, variance,

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P1BTTC104
Credit: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

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

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.

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)

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P1BTTC104
Credit: 2
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

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

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P1BTTC104 | **Contact hours: 24**
Credit: 2 | **Max. Marks: 50**
Duration of Examinations | **Minor Test1:10**
Minor Test1: 1.0 hour | **Minor Test 2: 10**
Minor Test2: 1.0 hour | **Major Test: 30**
Major Test: 2.5 hours | **Total: 50**

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. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

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

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY

SEMESTER – I

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

COURSE TITLE: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Course code: P1BTTC104	**Contact hours: 24**
Credit: 2	**Max. Marks: 50**
Duration of Examinations	**Minor Test1:10**
Minor Test1: 1.0 hour	**Minor Test 2: 10**
Minor Test2: 1.0 hour	**Major Test: 30**
Major Test: 2.5 hours	**Total: 50**

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

Semester: I

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

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY
Course code: P1BTTE108
Minor: 1.0 hours
Major: 1.0 hours
Major: 3.0hours

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

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

Course Outcome:

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

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

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

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

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

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

i. Artificial Intelligence and Its Foundations Definition and history of AI; Branches of AI: Machine Learning (ML), Deep Learning (DL): AI vs. traditional programming: Generative AI: ChatGPT, DeepSeek: AI vs. Biological Intelligence
ii. Biological Data; Types of biological data: imaging, experimental, clinical and environmental: Challenges in biological data analysis
iii. Computational Tools and Data Management, Need for computational tools in biology: Data storage and analysis: Cloud vs. server-based data storage and analysis: Data privacy and security: Algorithmic bias and fairness: Sources of bias in biological datasets

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

Semester: I

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

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY
Course code: P1BTTE108
Minor: 1.0 hours
Major: 1.0 hours
Major: 3.0hours

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

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

Semester: I

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

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY
Course code: P1BTTE108
Minor: 1.0 hours
Major: 1.0 hours
Major: 3.0hours

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

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 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%	2hours	25
External Examination	100%	2 hours	25
Total			50

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

Test I and Test II

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

Semester: I

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

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY
Course code: P1BTTE108
Minor: 1.0 hours
Major: 1.0 hours
Major: 3.0hours

Contact hours 24
Max. Marks: 50
Minor Test 1: 10
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. 7 out of 20 will be eligible to re-appear in the Test I and Test II only once.

Major Test

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

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

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

BOOKS RECOMMENDED

1. "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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

Semester: I

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

Course Title: ARTIFICIAL INTELLIGENCE IN BIOLOGY
Course code: P1BTTE108
Minor: 1.0 hours
Major: 1.0 hours
Major: 3.0hours

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

3. Future of AI in Biomedicine and Biotechnology" edited by Shankar Mukundrao Khade and Raj Gaura Mishra (2024) **IGI GLOBAL** Publisher, ISBN-13:979-8369354827

4. BIOTECHNOLOGICAL APPROACH TO SUSTAINABLE FARMING (AI-Driven Agriculture)" by Dr. ALOK KUMAR SRIVASTAV et al. (2023) ISBN-10,9355455534,ISBN-13,978-9355455536

5. Think Python: How to Think Like a Computer Scientist" by Allen B. Downey (**Shroff/O'Reilly** ,Publisher 2016) ISBN -10,9789352134755,ISBN-13,978-9352134755

6. Python Crash Course: A Hands-On, Project-Based Introduction to Programming" by Eric Matthes (2019) ISBN-10:1593279280,ISBN-13:978-1593279288

7. Machine Learning For Absolute Beginners: A Plain English Introduction" by Oliver Theobald

8. Machine Learning For Dummies" by John Paul Mueller and Luca Massaron (**Dummies** ,Publisher 2016)ISBN-10:1119245516,ISBN-13:978-1119245513

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

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

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

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P1BTTE109
Duration of Examinations
Minor Test: 1.0 hour
Major Test: 2.5 hours

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

Course Objective:

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

Course Outcome:

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

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

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

CO4: Analyze transcriptomic data and perform gene expression studies.

CO5: Explore epigenomic modifications and their impact on gene regulation

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

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

UNIT - II: INTRODUCTION TO GENOMICS

i. **Genomics:** C-value content and genome size: estimation methods, genome coverage, Sequencing and preprocessing, assembly: de-novo and reference based assembly, genome assemblers; assembly algorithms: de-Bruijn graph and Over-Layout

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P1BTTE109
Duration of Examinations
Minor Test: 1.0 hour
Major Test: 2.5 hours

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

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.
ii. **Whole exome sequencing**: Genomic vs exomic sequencing; Exome enrichment and sequencing, Reference alignment, Variant calling and annotation, copy number variants (CNVs). Applications of WES in disease research, clinical diagnostics, and personalized medicine, Ethical considerations and societal implications of WES
iii. **Epigenomics**: Introduction to Epigenetics: DNA methylation, histone modifications, and ATP-dependent chromatin remodelling, ChIP-seq, ATAC-seq, Bisulfite-seq, MeDIP-seq, etc, Data alignment, Peak Calling and Annotation, Differential peak analysis, Functional Interpretation and Integration, Single-Cell Epigenomics
iv. **Genome projects**: The Human genome project, HapMap Project, The 1000 genome project, The Human Epigenome Project (HEP), The Genome India Project (GIP) and The ENCODE Project

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P1BTTE109
Duration of Examinations
Minor Test: 1.0 hour
Major Test: 2.5 hours

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

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

Test I and Test II

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: COMPUTATIONAL GENOMICS

Course code: P1BTTE109
Duration of Examinations
Minor Test: 1.0 hour
Major Test: 2.5 hours

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

Major Test

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

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

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

BOOKS RECOMMENDED

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

Syllabus for the PG Programme (1 years) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: MICROBIOMICS
Course code: P1BTTE110
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test: 1.0 hours
Major Test: 2.5 hours

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

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

Course Outcome:

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

CO2. Manage and process sequencing data using appropriate formats and computing platforms.

CO3. Explore the diversity and ecological roles of microbiomes across environments.

CO4. Apply culturomics and metagenomic approaches to study unculturable microorganisms.

CO5. Analyse metagenomic data for taxonomic and functional insights.

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

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

UNIT - II: INTRODUCTION TO MICROBIOMICS

Syllabus for the PG Programme (1 years) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: MICROBIOMICS
Course code: P1BTTE110
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test: 1.0 hours
Major Test: 2.5 hours

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

i. Microbiomics: Overview of microbial diversity across different habitats, Host-Microbe Interactions, Human microbiome, extreme habitats microbiome, Plant microbiome, Concept of Holobiome; Human Microbiome Project and Earth Microbiology Project, The Earth BioGenome Project
ii. Culturomics: Isolation & cultivation of microbes, identification based on morphology, microscopy, biochemical characterization and molecular characterization, media engineering to cultivate yet to be cultured microorganism
iii. Metagenomics: Great plate anomaly, Metagenomic DNA extraction and sequencing, Sequencing quality and metagenome coverage estimation; Metagene centric approach (Metabarcoding, 16S rRNA, housekeeping genes): ASV vs OTU estimation, 16S rRNA; ITS databases and custom databases; Taxonomy databases and algorithm; diversity indices, alpha/beta diversity.
iv. Whole metagenome centric approach: metagenome assembly: algorithms and assemblers, downstream annotation: functional metagenomic databases and softwares; taxonomic classification and functional annotation; Pathway analysis; Comparative metagenomics; Concept of pan-microbiome, core microbiome and lineage specific microbiome

UNIT - III: METAGENOME ASSEMBLED GENOME AND METATRANSCRIPTOMICS

i. Metagenome assembled genomes (MAGs): Binning & Genome Reconstruction, bin contamination and completeness; MAG annotations, MAGs Databases, softwares and algorithms; Synthetic genomes and their applications: Genomic stability, Regulatory and societal implication, Intellectual property
ii. Metatranscriptomics: Overview of metatranscriptomics and its significance in microbial ecology, metatranscriptomics RNA extraction, rRNA depletion and mRNA enrichment; transcriptome sequencing, assembly and annotation, differential gene expression
iii. Metagenome-Wide Association Studies: Concept of MWAS, difference between MWAS and GWAS;
iv. Applications of microbiomics: Microbiome-based therapies and personalized medicine, Case study of MWAS in health, agriculture, and environment

Syllabus for the PG Programme (1 years) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: MICROBIOMICS
Course code: P1BTTE110
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test: 1.0 hours
Major Test: 2.5 hours

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

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

Test I and Test II

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

Syllabus for the PG Programme (1 years) as per NEP-2020

M.Sc. Biotechnology

SEMESTER – I

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

COURSE TITLE: MICROBIOMICS
Course code: P1BTTE110
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test: 1.0 hours
Major Test: 2.5 hours

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

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

Major Test

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

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

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

BOOKS RECOMMENDED

1. Zhong Wang (2022) Introduction to Computational Metagenomics World Scientific Publishing Company. ISBN: 9789811242489, 9811242488
2. Rolf Daniel, Wolfgang R. Streit (2018) Metagenomics: Methods and Protocols Springer New york. ISBN: 9781493982745, 1493982745
3. John Parkinson, Robert G. Beiko, Will Hsiao (2018) Microbiome Analysis: Methods and Protocols. Springer New York. ISBN: 9781493987283, 1493987283
4. Muniyandi Nagarajan (2024) Metagenomics: Perspectives, Methods, and Applications, Elsevier Science ISBN: 9780323916318, 0323916317

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2027, May 20228 & May 2029

COURSE TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course code: P1BTTC201 | **Contact hours: 48**

Duration of Examinations | **Credits: 4**

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

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

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

Major Test: 60

Total: 100

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

Course Outcome:

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

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

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

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

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

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

CO6: Understand Immune tolerance and principles of autoimmunity

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

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

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

UNIT - I: INTRODUCION TO THE IMMUNE SYSTEM

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2027, May 20228 & May 2029

COURSE TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course code: P1BTTC201	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.0 hour	**Max. Marks: 100**
Minor Test2: 1.0 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

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

UNIT - II: HUMORAL AND CELL MEDIATED IMMUNITY

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

UNIT - III: FAILURE OF THE IMMUNE SYSTEM

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

UNIT IV: IMMUNODIAGNOSTIC PROCEDURES

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

UNIT - V: IMMUNOLOGY-BASED THERAPIES

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2027, May 20228 & May 2029

COURSE TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course code: P1BTTC201 | **Contact hours: 48**

Duration of Examinations | **Credits: 4**

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

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

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

Major Test: 60

Total: 100

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2027, May 20228 & May 2029

COURSE TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course code: P1BTTC201
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 3.0 hours

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

Test I and Test II

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

Major Test

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

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

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

BOOKS RECOMMENDED

1. Kuby Immunology; 8th Edition 2023 By Jenni Punt & Sharon Stranford
2. Cellular And Molecular Immunology 10th Edition 2022 By Abul K Abbas
3. Paul's Fundamental Immunology by Martin Flajnik, Publisher: ‎Wolters Kluwer Health; 8th edition (19 October 2022)
4. Immunology, International 9th Edition 2020 by David Male
5. Coleman, R.M., Lombard, M.F. and Sicard, R.E. (1992). Fundamental Immunology. Wm. C. Brown publishers, USA.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

Syllabi for the examinations to be held in the years May 2027, May 20228 & May 2029

COURSE TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course code: P1BTTC201	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.0 hour	**Max. Marks: 100**
Minor Test2: 1.0 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: FUNDAMENTALS OF PLANT BIOTECHNOLOGY

Course code: P1BTTC202	**Contact hours: 24**
Duration of Examinations	**Credits: 2**
Minor Test1: 1 hour	**Max. Marks: 50**
Minor Test2: 1 hour	**Minor Test 1: 10**
Major Test: 2.5 hours	**Minor Test 2: 10**
	Major Test: 30
	Total: 50

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

Course Outcome:

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

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

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

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

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

UNIT-I: TISSUE CULTURE

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: FUNDAMENTALS OF PLANT BIOTECHNOLOGY

Course code: P1BTTC202 | **Contact hours: 24**

Duration of Examinations | **Credits: 2**

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

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

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

Major Test: 30

Total: 50

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

UNIT-II: GENETIC TRANSFORMATION

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

UNIT-III: APPLICATIONS OF PLANT BIOTECHNOLOGY

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: FUNDAMENTALS OF PLANT BIOTECHNOLOGY

Course code: P1BTTC202 **Contact hours: 24**

Duration of Examinations **Credits: 2**

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

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

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

Major Test: 30

Total: 50

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

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

Test I and Test II

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

Major Test

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

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: FUNDAMENTALS OF PLANT BIOTECHNOLOGY

Course code: P1BTTC202	**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

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

BOOKS RECOMMENDED:

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P1BTTC203
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

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

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

Course Outcome:

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

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

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

UNIT I: FUNDAMENTALS OF ANIMAL CELL CULTURE

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

UNIT II: ANIMAL REPRODUCTIVE BIOTECHNOLOGY AND BIOETHICS

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P1BTTC203 | **Contact hours: 24**
Duration of Examinations | **Credits: 2**
Minor Test1: 1.0 hour | **Max. Marks: 50**
Minor Test2: 1.0 hour | **Minor Test 1: 10**
Major Test: 2.5 hours | **Minor Test 2: 10**
Major Test: 30
Total: 50

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

UNIT III: APPLICATIONS OF ANIMAL CELL CULTURE

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P1BTTC203
Duration of Examinations
Minor Test1: 1.0 hour
Minor Test2: 1.0 hour
Major Test: 2.5 hours

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

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

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

Test I and Test II

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

Major Test

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

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER II

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

COURSE TITLE: APPLIED ANIMAL BIOTECHNOLOGY

Course code: P1BTTC203	**Contact hours: 24**
Duration of Examinations	**Credits: 2**
Minor Test1: 1.0 hour	**Max. Marks: 50**
Minor Test2: 1.0 hour	**Minor Test 1: 10**
Major Test: 2.5 hours	**Minor Test 2: 10**
	Major Test: 30
	Total: 50

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

BOOKS RECOMMENDED:

1. Freshney RI. *Culture of animal cells: A manual of Basic Technique*. 5th ed. John Wiley & Sons Inc.; 2007.
2. Sivakumar ADL, Sivakumar SM. *Biotechnology of Animal Reproduction*. 1st ed. Cambridge: Cambridge University Press; 2018. p. 320. ISBN 978-1107152884.
3. Gordon I. *Reproductive Techniques in Farm animals*. CABI; 2005.
4. Portner R. *Animal Cell Biotechnology*. Humana Press; 2007.
5. Springer TA. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press; 1985.
6. Bloom BR, Lambert P-H. *The Vaccine Book*. Academic Press; 2002.
7. Krishna VS. *Bioethics and Bioethics in Biotechnology*. New Age International (P) Limited; 2007.
8. Gupta NK. *Animal Cell Culture and Biotechnology: Methods and Applications*. 1st ed. Cham: Springer; 2017. p. 232. ISBN 978-3319509325.
9. Choudhury HN, Anwar MA. *Principles of Animal Biotechnology*. 1st ed. Boca Raton: CRC Press; 2020. p. 340. ISBN 978-0367331475.
10. Sevilha AMVL. *Transgenic Animals in Agriculture*. 1st ed. Dordrecht: Springer; 2007. p. 288. ISBN 978-1402054246.
11. Glick BR, Pasternak JJ. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. 5th ed. Washington: ASM Press; 2017. p. 512. ISBN 978-1555819203.
12. Singleton WT, Srinivasan KSB. *Animal Genomics: Principles and Applications*. 1st ed. Hoboken: Wiley; 2019. p. 540. ISBN 978-1119510879.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER-II

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

Course Title: BIOENTREPRENEURSHIP
Course code: P1BTTE207
Course Credits: 2
Duration of Examinations:
Minor Test 1: 1 hour
Major Test: 2.5 hours

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

Course Objectives:

This course will provide an in-depth understanding of bioentrepreneurship, focusing on the intersection of biotechnology, innovation, and business strategies. The course covers the essential aspects of starting, managing, and scaling a biotechnology company, including market analysis, financing, regulatory considerations, and commercialization strategies. Students will engage with case studies, develop business plans, and explore real-world examples of successful biotech startups.

Course Outcome:

CO1. Define and explain the concept of bioentrepreneurship and evaluate its relevance and scope in biotechnology and allied life sciences.

CO2. Identify innovative opportunities in biotechnology and apply out-of-the-box thinking to explore emerging technologies and business models.

CO3. Analyse different entrepreneurial domains (agri-biotech, pharma-biotech, microbial biotech, etc.) and assess the basic characteristics and motivation factors for becoming an entrepreneur.

CO4. Develop a business plan addressing feasibility, financial management, statutory/legal requirements, and partnership strategies.

CO5. Identify funding opportunities and differentiate between various financial instruments like seed money, venture capital, angel investing, government schemes (BIRAC, SISFS, etc.).

UNIT -I INTRODUCTION TO BIOENTREPRENEURSHIP

i. Overview of Bioentrepreneurship; Definition, scope, and importance of bioentrepreneurship.

ii. Integration of science, technology and business for bioentrepreneurship; creativity; innovation – types, out of box thinking

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER-II

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

Course Title: BIOENTREPRENEURSHIP
Course code: P1BTTE207
Course Credits: 2
Duration of Examinations:
Minor Test 1: 1 hour
Major Test: 2.5 hours

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

iii. Various Entrepreneurial opportunities in Biotechnology/Microbiology/ Biochemistry; New evolving areas in Biotechnology

iv. Social and business entrepreneurship; basic characteristics of entrepreneurship; Developing entrepreneurship through training and motivation

UNIT -II MANAGING ENTREPRENEURSHIP

i. Translating scientific research into commercially viable products; IP and technology transfer from academic/research institutions

ii. Business plan preparation including statutory and legal requirements, Business feasibility study, financial management, collaborations and partnerships

iii. Assessment of market demand for potential product(s) of interest; Market conditions, segmentation; Identifying needs of customers including gaps in the market.

iv. Branding issues; Developing distribution channels; Pricing/Competition; Promotion/ Advertising

UNIT -III DEVELOPING A BUSINESS MODEL FOR STARTUPS

i. Development and upgradation of technology, Quality control; Regulatory Compliances and procedures

ii. Concept of startups and associated challenges, stages of startups, incubation centre, acceleration centre

iii. Understanding the biotech venture funding lifecycle: Seed money, venture capital, angel investors, government grants, and crowdfunding.

iv. Startups/companies working in different areas of specialization (agri-based, pharma -based etc.); Case studies of successful biotech startups.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER-II

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

Course Title: BIOENTREPRENEURSHIP
Course code: P1BTTE207
Course Credits: 2
Duration of Examinations:
Minor Test 1: 1 hour
Major Test: 2.5 hours

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	(%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50

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

Test I and Test II

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

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 10 parts (minimum 01 from each unit) of 1 mark

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. Biotechnology

SEMESTER-II

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

Course Title: BIOENTREPRENEURSHIP
Course code: P1BTTE207
Course Credits: 2
Duration of Examinations:
Minor Test 1: 1 hour
Major Test: 2.5 hours

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

each. Section B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

BOOKS RECOMNDEDDED:

1. Gupta A, George G, Fewer TJ; (2024) Venture Meets Mission: Aligning People, Purpose, and Profit to Innovate and Transform Society, Stanford Business Books.
2. Ahmetoglu et al., (2017) The Wiley handbook of entrepreneurship, John Wiley and sons.
3. Craig S; (2020) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Academic Press (Elsevier), UK.
4. Patzelt, H, Brenner T; (2008) Handbook of Bioentrepreneurship, Springer Publications.
5. Hopkins T and Perui O; (2019) The smart start up, Jaico publishing house, Mumbai
6. Zaware N; (2018) Entrepreneurship development and start up management, Educreation publishing, New Delhi
7. Bhatt AK, Bhatia RK, Bhalla TC; (2023) Basic Biotechniques for Bioprocess and Bioentrepreneurship, Academic Press Inc.
8. Shimasaki C; (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Academic Press.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

Course Title: IPRS AND BIOETHICS
Course code: P1BTTE208
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

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

Course objectives: This course will cater to various aspects of IPR like procedure, limit and variety of patent laws. Further it will also address bioethical concerns arising from the commercialization of biological products, GM foods, stem cell research, organ transplantation etc.

Course Outcome:

CO1: Students will gain knowledge about the basics of the primary forms of intellectual property rights, the right of ownership, scope of protection as well as the ways to create and to extract value from IP.

CO2: Students will able to analyze the effects of intellectual property rights on society as a whole.

CO3: Students will able to understand different aspects of bioethical issues arises due to advancement in Biotechnology.

UNIT-I: INTELLECTUAL PROPERTY

i. Introduction to IPRs; various types of IPRs: Trademarks, Copyrights, Geographical indications, Trade Secrets; Role of IPRs in Biotechnology

ii. Patents: Criteria for patenting in Biotechnology/Microbiology/Biochemistry: novelty, non-obviousness, and utility; Patentable and non-patentable inventions; Biological Patents; Purpose of patents

iii. *Sui generis* system of IPRs: Need for *Sui generis* system; Plant variety protection, Database protection, other forms of *Sui generis* protection

iv. Introduction to WIPO and TRIPS, various provisions in the TRIPS Agreement; Indian legislations for the protection of various types of IPs; National Biodiversity protection initiatives

UNIT-II: PATENTING PROCESS

i. Specific challenges in biological patenting: gene patents, diagnostic patents and biopharmaceuticals patents

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

Course Title: IPRS AND BIOETHICS
Course code: P1BTTE208
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

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

ii. Patent application: various components of Patent application, patent search, patent filing, Pre grant and post grant opposition, Patent Cooperation Treaty (PCT)

iii. Introduction to Indian patent office, US patent office and European patent office

iv. Patent Licensing; Technology Transfer; The role of technology transfer offices in academic and research institutions; Patent Infringement

UNIT-III: BIOETHICS

i. Introduction to Bioethics, Statement of Bioethical Principles; Rules and regulations of ethical issues in India

ii. Traditional knowledge and bioethics; Gene therapy: Somatic genome editing; Germ line Gene therapy Moratorium; Medical privacy and genetic discrimination

iii. Bioethics in research: Stem cells, animal cloning; Use of animals in research, animal rights; Human experimentation; Organ transplantation

iv. Genetically Modified foods: Environmental risk, labelling and public opinion; Protection of environment and biodiversity; Biopiracy, case studies

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

Course Title: IPRS AND BIOETHICS
Course code: P1BTTE208
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

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

	covered in the examination	the examination	(Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50

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

Test I and Test II

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

Major Test

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

BOOKS RECOMNDEDDED:

1. Keswani C and Possas C (2024); Intellectual Property Issues in Life Sciences: Disputes and Controversies, CRC Press USA
2. Stasi A and David TWC (2023); An Introduction to Legal, Regulatory and Intellectual Property Rights Issues in Biotechnology, Bentham Science Publishers UAE.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

Course Title: IPRS AND BIOETHICS
Course code: P1BTTE208
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test: 2.5 Hours

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

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.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION

Course code: P1BTTE209
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

Course objective: The objectives of this course are to give background on history of science, emphasizing methodologies used to do research, use framework of these methodologies for understanding effective lab practices and scientific communication and appreciate scientific ethics.

Course Outcome:

CO1: Assess the different methodologies and approaches used in scientific research.

CO2: Build on the concepts of getting ready for research, choosing a research topic, lab, and mentor, and maintaining a lab journal.

CO3: Establish clear objectives for communication; identify outcomes and results; analyze obstacles to effective communication and nonverbal clues

CO4: Develop computing abilities for scientific research and create and deliver formal scientific presentations.

CO5: Determine the elements of a scientific report, formulate a research article, learn the scientific communication process, and assess ethical issues.

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; Scientific poster preparation & presentation
iii. Computing skills for scientific research - web browsing for information search; Search engines and their mechanism of searching

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-I

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

COURSE TITLE: RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION

Course code: P1BTTE209
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

iv. Hidden Web and its importance in scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness.

UNIT III: SCIENTIFIC COMMUNICATION

i. Technical writing skills - types of reports; layout of a formal report; Scientific writing skills - importance of communicating science;
ii. Problems while writing a scientific document; plagiarism, Software for plagiarism
iii. Scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts
iv. Publishing scientific papers - peer review process and problems, recent developments such as open access and nonblind review; characteristics of effective technical communication; scientific presentations; ethical issues, scientific misconduct.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION

Course code: P1BTTE209
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

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

Test I and Test II

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

Major Test

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

BOOKS RECOMMENDED:

1. 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

Syllabus for the PG Programme (1 year) as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: RESEARCH PROJECT

Course code: P1BTRC211 **Contact hours: 192**

Duration of Examinations **Credits: 16**

Max. Marks: 400

Dissertation: 200

Presentation and Viva: 200

COURSE OBJECTIVE:

This course bridges theoretical learning with real-world problem-solving, enabling postgraduate students to apply their academic knowledge through hands-on research projects. Students will develop critical thinking, strengthen data analysis skills, and cultivate a problem-solving mindset. Emphasis is placed on self-directed learning, fostering research competencies, and gaining advanced knowledge through project-based study.

COURSE OUTCOMES:

Upon completion of the project work course, student will be able to

CO1: Apply academic concepts and theoretical knowledge to address real-world problems.

CO2: Demonstrate research competencies, including literature review, data collection, data analysis, and interpretation of results.

CO3: Draw meaningful conclusions from research findings and present them effectively.

CO4: Communicate research outcomes clearly in written, oral, and visual formats.

CO5: Collaborate effectively in teams, demonstrating strong interpersonal and time management skills.

CO6: Exhibit readiness for professional roles or advanced academic research through enhanced problem-solving and self-directed learning abilities.

Scheme of Research Project and Dissertation

Allotment of Supervisor

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

Research Work and Dissertation Writing:

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

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

Syllabus for the PG Programme (1 year) as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: RESEARCH PROJECT

Course code: P1BTRC211 **Contact hours: 192**

Duration of Examinations **Credits: 16**

Max. Marks: 400

Dissertation: 200

Presentation and Viva: 200

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: P1BTRC211 **Contact hours: 192**
Duration of Examinations **Credits: 16**
Max. Marks: 400
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

Syllabus for the PG Programme (1 year) as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: RESEARCH PROJECT

Course code: P1BTRC211 **Contact hours: 192**

Duration of Examinations **Credits: 16**

Max. Marks: 400

Dissertation: 200

Presentation and Viva: 200

University Roll No. of the candidate, name(s) of the Supervisor, Department, College, University and year of submission.

5. A Declaration of Academic Honesty and Integrity by Candidate: A declaration of Academic honesty and integrity is required to be included along with every dissertation. The format of this declaration is given in Annexure-I attached.

6. Certificate from Supervisor (Annexure-II):

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

Evaluation of the dissertation:

1. The project report/dissertation shall be evaluated by the external expert from other University/Institutes

2. The students shall be declared pass in the research project course if she/he secures minimum 40% marks (Dissertation and viva).

Syllabus for the PG Programme (1 year) as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: RESEARCH PROJECT

Course code: P1BTRC211 **Contact hours: 192**

Duration of Examinations **Credits: 16**

Max. Marks: 400

Dissertation: 200

Presentation and Viva: 200

ANNEXURE-I

CERTIFICATE

The work embodied in this dissertation entitled " .... '' (write the title in capital letters) has been carried out by me under the supervision of .... (give the name of the Guide).

This work is original and has not been submitted byme for the award of any other degree of University of Jammu or any other University. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated.

.....

.....

(Signature and Name of the Candidate)

Date: .....

Place: .....

Syllabus for the PG Programme (1 year) as per NEP-2020
M.Sc. BIOTECHNOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May 2029

COURSE TITLE: RESEARCH PROJECT
Course code: P1BTRC211 **Contact hours: 192**
Duration of Examinations **Credits: 16**
Max. Marks: 400
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

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: FUNCTIONAL NUTRACEUTICALS

Course code: P1BTTE210
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

Course Outcomes: This course explores the biochemical and molecular foundations of human nutrition, focusing on nutrient-gene interactions, metabolic regulation, clinical implications of nutrient deficiencies and excesses, and current developments in nutraceuticals and functional foods. Students will gain insights into the biochemical basis of nutrient metabolism and the role of nutrition in health, disease prevention, and therapeutic strategies.

Course Outcome:

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

CO1. Differentiate between nutrigenomics and nutrigenetics and explain the role of genetic and epigenetic mechanisms in nutrition.

CO2. Explain the molecular mechanisms behind metabolic disorders like diabetes, obesity, and metabolic syndrome, including mitochondrial dysfunction and bioenergetics.

CO3. Apply knowledge of molecular techniques (e.g., PCR, SNP analysis, gene expression profiling) in the context of nutritional genomics research. CO4. Assess the role of hormones (leptin, ghrelin, insulin, etc.) and signalling pathways (AMPK, mTOR, PPARs) in metabolism and appetite regulation.

CO5. Explain the functions and responsibilities of FSSAI and DCGI in regulating food and pharmaceutical products in India.

UNIT 1: NUTRIENT-GENE INTERACTIONS AND NUTRITIONAL GENOMICS

i. Nutrigenomics vs Nutrigenetics, Classification and biochemical mechanisms of nutraceuticals.
ii. Role of genetic polymorphisms in nutrient metabolism (e.g., MTHFR and folate metabolism), Epigenetic modifications influenced by diet (DNA methylation, histone modification).
iii. Molecular basis of metabolic disorders: Diabetes, Metabolic Syndrome, Obesity, Bioenergetics, and mitochondrial function in nutrition.
iv. Molecular techniques in nutritional genomics research.

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: FUNCTIONAL NUTRACEUTICALS

Course code: P1BTTE210
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

UNIT 2: 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.
iv. Clinical biomarkers of nutritional status (serum proteins, lipid profile, vitamin levels), Biochemical basis of malnutrition and overnutrition.

UNIT 3: ADVANCED THERAPEUTIC NUTRITION OF IMMUNE AND GUT HEALTH

i. Dietary supplements: Efficacy, safety, regulatory aspects; Concept of Parenteral and enteral nutrition: Biochemical considerations in formulation and delivery.
ii. Overview of Microbiome-nutrient interactions, Biochemistry of Probiotics, prebiotics, and synbiotics.
iii. Gut-associated lymphoid tissue (GALT) and nutrition; Gut microbiota and its metabolic products (SCFAs, bile acids); Nutrient absorption and metabolism with aging, Role of dietary fiber in immune-gut axis; and Leaky gut syndrome and nutritional modulation.
iv. FSSAI: Overview, functions, food safety regulations, licensing, and recent developments. DCGI: Role in drug regulation, clinical trials, approval processes, and quality control of pharmaceuticals.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: FUNCTIONAL NUTRACEUTICALS

Course code: P1BTTE210
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	5 + 5
TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50

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

Test I and Test II

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

Major Test

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

BOOKS RECOMMENDED:

Syllabus for the PG Programme (1 year) as per NEP-2020

M.Sc. BIOTECHNOLOGY
SEMESTER-II

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

COURSE TITLE: FUNCTIONAL NUTRACEUTICALS

Course code: P1BTTE210
Duration of Examinations
Credits: 2
Minor Test1: 1.0 hour
Minor Test 2:1.0 hour
Major Test:2.5 Hours

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

1. Haslberger, A.G. 2022. Advances in Precision Nutrition, Personalization and Healthy Aging. Hardcover ISBN 978-3-031-10152-6, Softcover ISBN 978-3-031-10155-7.
2. Litwack, G. 2021. Human Biochemistry. Academic Press. ISBN: 9780323910538
3. Biswas, D., and Rahaman, S.O.(Eds.). 2020. Gut Microbiome and Its Impact on Health and Disease. Springer.
4. Nelson, D. L., and Cox, M. M. (2017). Lehninger Principles of Biochemistry. W.H. Freeman and Company.
5. Ferguson, L.R. 2014 (e-book 2016). Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition. CRC Press.
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.