UNIVERSITY OF JAMMU

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

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(25/Oct./Adp./10)

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

Two Year Post Graduate Programme under NEP-2020

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

One Year Post Graduate Programme under NEP-2020

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

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

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/10838-850
Dated: 09/10/25

Copy for information and necessary action to:

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

Rebecca 7/10/25
Joint Registrar (Academic)

7/10/25 7/10/25

SYLLABI FRAMEWORK PG PROGRAMME MICROBIOLOGY (1 YEAR)

PG Syllabi 2025															
S.No.	Course No.	Course Title	No. of Credits			Course Type	Marks		Nature of Course				SWAYAM/MOOC	Vocational Course	Research Project/ Summer Internship/ Dissertation
				Credits Level	Credit Points	Core/Elective/Any other	Theory	Practical	Global	National	Regional	Skill			
1.	P1MBTC101	Bioprocess Technology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
2.	P1MBTC102	Fundamental of Mycology and Phycology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
3.	P1MBTC103	Food and Environmental Microbiology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
4.	P1MBPC104	Fundamental of Bioinformatics and Biostatistics	2	6.5	13	Core	50	-	✓	✓	✓	✓			
5.	P1MBPC105	Laboratory course in Bioprocess Technology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
6.	P1MBPC106	Laboratory course in Fundamental of Mycology and Phycology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
7.	P1MBTE107	Laboratory course in Fundamental of Bioinformatics and Biostatistics	2	6.5	13	Core	-	50	✓	✓	✓	✓			
8.	P1MBTE108	Artificial Intelligence in Biology	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
9.	P1MBTE109	Computational Genomics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
10.	P1MBTE110	Microbiomics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
11.	P1MBTE111	Lab Course in Artificial Intelligence in Biology	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
12.	P1MBTE112	Lab Course in Computational Genomics	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
13.	P1MBTE113	Lab Course in Microbiomics	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
14.	P1MBTC201	Immunology and Immunotechnology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
15.	P1MBTC202	Clinical Microbiology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
16.	P1MBPC203	Laboratory course in Immunology and Immunotechnology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
17.	P1MBPC204	Laboratory course in Clinical Microbiology	2	6.5	13	Core	-	50	✓	✓	✓	✓			
18.	P1MBTE206	IPRs and Bioethics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
19.	P1MBTE207	Bio Entrepreneurship	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
20.	P1MBTE208	Research methodology and Scientific communication	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
21.	P1MBTE209	Functional Nutraceuticals	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
22.	P1MBRC210	Research Project (Project presentation +Viva-Voce + Dissertation)	08	6.5	52	Core	200	-	✓	✓	✓	✓			

MSC MICROBIOLOGY NEP 2020

Scheme of one year Post graduate Microbiology programme

Total Credits:54

Semester I

COURSE CODE	PAPER	CREDITS
	Core Courses	
P1MBTC101	Bioprocess Technology	4
P1MBTC102	Fundamental of Mycology and Phycology	4
P1MBTC103	Food and Environmental Microbiology	4
P1MBPC104	Fundamental of Bioinformatics and Biostatistics	2
P1MBPC105	Laboratory course in Bioprocess Technology	2
P1MBPC106	Laboratory course in Fundamental of Mycology and Phycology	2
P1MBTE107	Laboratory course in Fundamental of Bioinformatics and Biostatistics	2
	Electives*	
P1MBTE108	Artificial Intelligence in Biology	2
P1MBTE109	Computational Genomics	2
P1MBTE110	Microbiomics	2
P1MBTE111	Lab Course in Artificial Intelligence in Biology	2
P1MBTE112	Lab Course in Computational Genomics	2
P1MBTE113	Lab Course in Microbiomics	2
TOTAL		24

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

Semester II

COURSE CODE	PAPER	CREDITS
	Core Courses	
P1MBTC201	Immunology and Immunotechnology	4
P1MBTC202	Clinical Microbiology	4
P1MBPC203	Laboratory course in Immunology and Immunotechnology	2
P1MBPC204	Laboratory course in Clinical Microbiology	2
	Electives*	
P1MBTE206	IPRs and Bioethics	2
P1MBTE207	Bio Entrepreneurship	2
P1MBTE208	Research methodology and Scientific communication	2
P1MBTE209	Functional Nutraceuticals	2
P1MBRC210	Research Project (Project presentation +Viva-Voce + Dissertation)	16
TOTAL		30

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

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

Course Title: BIOPROCESS TECHNOLOGY
Course code: P1MBTC101
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

COURSE OBJECTIVE: 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:
CO303.1: 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.
CO303.2: Able to design bioreactors, formulate and operate scaled-up bioconversion processes
CO303.3: Able to develop process control systems, instrumentation, and modeling.
CO303.4: Able to conduct practice-based tasks related to bioprocessing in a responsible, safe, voluntary, self-motivated a

UNIT - I: OVERVIEW OF BIOPROCESSING

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

UNIT-II: BIOREACTORS, BIOPROCESS MONITORING AND CONTROL

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

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Major Test: 3.0 hours

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

UNIT-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.
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	Time allotted for the examination	%Weightage (Marks)

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M.Sc. MICROBIOLOGY
SEMESTER I
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Major Test: 3.0 hours

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

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

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

Test I and Test II

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

Major Test

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

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

Course Title: BIOPROCESS TECHNOLOGY
Course code: P1MBTC101
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
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Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

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. 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.

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER 1
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: Fundamentals of Mycology and Phycology
Course code: P1MBTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

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

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

UNIT- I: INTRODUCTION TO FUNGI

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

UNIT - II: HIGHER FUNGI

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

UNIT - IV: FUNGI AND ECOSYSTEM

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

COURSE TITLE: Fundamentals of Mycology and Phycology
Course code: P1MBTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

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

UNIT - V: ALGAE

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

UNIT - V: ALGAE AND ECOSYSTEM

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

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M.Sc. MICROBIOLOGY
SEMESTER I
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COURSE TITLE: Fundamentals of Mycology and Phycology
Course code: P1MBTC102
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

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

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

Test I and Test II

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

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I

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Credits: 4
Minor Test 1: 20
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Total: 100

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

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

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

BOOKS RECOMMENDED:

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

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I

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

Course Title: FOOD AND ENVIRONMENTAL MICROBIOLOGY

Course code: P1MBTC103
Duration of Examinations
Minor Test 1: 1 hour
Minor Test 2: 1 hour
Major Test: 3 hours

Contact hours: 24
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60

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

COURSE OUTCOME:

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

UNIT-I: INTRODUCTION TO FOOD AND ENVIRONMENTAL MICROBIOLOGY

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

UNIT-II: FOOD PRESERVATION AND FERMENTATION

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

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M.Sc. MICROBIOLOGY
SEMESTER I

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

UNIT - III: FOOD SPOILAGE AND FOOD SAFETY

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

UNIT - IV: FOOD BORNE INFECTIONS AND INTOXICATIONS

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

UNIT-V: ENVIRONMENTAL WASTE TREATMENT, BIODEGRADATION AND BIODETERIORATION

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

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

Course Title: FOOD AND ENVIRONMENTAL MICROBIOLOGY

Course code: P1MBTC103 | **Contact hours: 24**
Duration of Examinations | **Credits: 4**
Minor Test 1: 1 hour | **Max. Marks: 100**
Minor Test 2: 1 hour | **Minor Test1: 20**
Major Test: 3 hours | **Minor Test2: 20**
Major Test: 60

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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

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

Test I and Test II

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

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02

Syllabi for 1 year PG Program as per NEP 2020
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Course Title: FOOD AND ENVIRONMENTAL MICROBIOLOGY

Course code: P1MBTC103
Duration of Examinations
Minor Test 1: 1 hour
Minor Test 2: 1 hour
Major Test: 3 hours

Contact hours: 24
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60

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

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2026, Dec. 2027 & Dec. 2028

Course Title: FUNDAMENTALS OF BIOINFORMATICS AND BIOSTATISTICS
Course Code: P1MB PC104
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

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

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

UNIT I: STATISTICAL METHODS AND INFERENCE

i. **Descriptive Statistics and Probability Fundamentals-** Measures of central tendency: Mean, median, and mode; Measures of dispersion: Range, variance, standard deviation; Fundamentals of probability: Definitions, types (classical, empirical, and subjective); Combinatorics: Permutations and combinations; basic probability computations
ii. **Probability Distributions and Statistical Hypotheses-** Theoretical probability distributions: Binomial, Poisson, and Normal; Introduction to hypothesis testing: Null and alternative hypotheses; Statistical errors: Type I and Type II errors
iii. **Inferential Statistical Techniques-** Tests of significance: *t*-test (independent and paired), chi-square test; Analysis of variance (ANOVA): One-way and two-way ANOVA
iv. **Correlation and Regression Analysis-** Simple correlation: Concepts, calculation, and interpretation; Simple linear regression: Estimation of parameters, model interpretation; Application and limitations in predictive analysis.

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Minor Test 1: 10
Minor Test 2: 10
Major Test: 30

UNIT II: BIOINFORMATICS AND BIOLOGICAL DATABASES

i. **Introduction to Bioinformatics-** Role of the internet in modern biological research; Scope and applications of bioinformatics in life sciences; Overview and classification of biological databases: Primary databases, Secondary databases, Composite database
ii. **Nucleotide Sequence Databases-** Structure, content, and access to major nucleotide databases: GenBank (NCBI), EMBL-EBI Nucleotide Sequence Database, DDBJ (DNA Data Bank of Japan)
iii. **Protein Sequence Databases-** Key repositories for protein sequence information; SWISS-PROT, TrEMBL, UniProt, PROSITE and Pfam, OWL
iv. **Structural Databases and Classification Systems-** Resources for macromolecular 3D structures: Protein Data Bank (PDB), Molecular Modelling Database (MMDB), Nucleic Acid Database (NDB); Structural classification systems: SCOP (Structural Classification of Proteins), CATH (Class, Architecture, Topology, Homologous superfamily)

UNIT III: INFORMATION RETRIEVAL AND COMPUTATIONAL ANALYSIS OF BIOLOGICAL DATABASES

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Syllabi for 1 year PG Program as per NEP 2020
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SEMESTER I
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TEST II (after 60days)	21 to 40%	1 hour	05+ 05
Theory	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

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

Test I and Test II:

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Major Test:

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

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

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

BOOKS RECOMMENDED:

1. Baxivanis, A.D. and Francis Onellette, B.F. (2020) Bioinformatics. Wiley Interscience, John Wiley and sons New York.
2. Lesk, AM (2019). Introduction to Bioinformatics 5th edition. Oxford University press.
3. Higgs PG, Attwood T.K. (2013) Bioinformatics and Molecular Evolution. Blackwell Publications
4. Zweig G, Sherma J (2016) Principles, statistics and applications: Analytical methods. Academy Press.
1. Attwood, T.K. and Parry- Smith, D.J. (1999) Introduction to bioinformatics. Pearson Education, Singapore.
2. Curtin, D.P. et. al., (1999). Information technology. Tata McGraw-Hill Publishing Company, New Delhi.
3. Dhar M.K. and Kaul, S (1997) Statistics in Biology. Malhotra Brothers, Jammu.

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
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: P1MBTE108
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5hours

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

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

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

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

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

UNIT 2: MACHINE LEARNING AND DEEP LEARNING

i. Machine learning;Types of ML: Supervised, unsupervised, Reinforcement learning;Use cases in biology: AlphaFold, trRosetta, AIDDISON;Common tools and libraries: BioPython, EMBOSS, etc.
ii. Deep learning ;Basics of neural networks: Neurons, layers, weights (conceptual)

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iii. Deep Learning architectures, CNNs and RNNs: Applications, advantages, and limitations in biology
iv. Programming languages: Python, BioPython, R, Shell/Bash; Practical examples and hands-on coding exercises. Programming without coding

UNIT 3: APPLICATIONS IN BIOLOGY

i. Bioinformatics: Overview of commonly used AI-based tools and databases for nucleic acid, protein, metabolite analysis
ii. Drug discovery and development: Target identification and validation: Lead discovery and optimisation: Preclinical and clinical trial data analysis: Personalized medicine:Drug repurposing using molecular and clinical data
iii. Diagnostics and precision medicine:Analysis of medical images (e.g., X-rays, MRIs, CT scans) using CNNs: Genomic data analysis for diagnosis and subtyping of disease
iv. 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

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

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BOOKS RECOMMENDED

1. "In Silicon Dreams: How Artificial Intelligence and Biotechnology Will Create the Medicines of the Future" by Brian S. Halibut (**WILEY** ,Publisher) 1st Edition 2021,ISBN-113:978-1119745570 ISBN-10:1119745578
2. NEXT-GEN BIOLOGY: Ai's Transformative Impact On Life Sciences: Ai Innovations In Biotechnology, Healthcare, And Agriculture" by Anita Margret A,Chrisanne Freeman,Merlyn Diana A S (2025) ISBN-10:9365542308 ,ISBN:13:978-93655542301
3. Future of AI in Biomedicine and Biotechnology" edited by Shankar Mukundrao Khade and Raj Gaura Mishra (2024) **IGI GLOBAL** Publisher , ISBN-13:979-8369354827
4. BIOTECHNOLOGICAL APPROACH TO SUSTAINABLE FARMING (AI-Driven Agriculture)" by Dr. ALOK KUMAR SRIVASTAV et al. (2023) ISBN-10,9355455534,ISBN-13,978-9355455536
5. Think Python: How to Think Like a Computer Scientist" by Allen B. Downey (**Shroff/O'Reilly**, Publisher 2016) ISBN -10,9789352134755, ISBN-13,978-9352134755

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Minor Test 1: 10
Minor Test 2: 10
Major Test: 30
Total: 50 marks

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

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
Syllabi for the examinations to be held in the years May 2026, May 2027 & May. 2028

Course Title: COMPUTATIONAL GENOMICS
Course code: P1MBTE109
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5hours

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

COURSE OBJECTIVE:

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

COURSE OBJECTIVE:

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

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

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

UNIT - II: INTRODUCTION TO GENOMICS

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

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

ii. **Genome Annotation**: Gene prediction: tools and models, genome annotations: determining the functions of individual genes; functional databases

iii. **Comparative Genomics**: Synteny and whole-genome alignment, Molecular phylogenetics and phylogenomics, Adaptive evolution; Concept of Pangenomes and Super reference genome; Core genome and accessory genome, population genomics

iv. **Genome wide association studies** (GWAS): Overview, Identifying genetic associations; Statistical Association Testing, Rare variant analysis; Genotyping.

UNIT - III: FUNCTIONAL GENOMICS AND EPIGENOMICS

i. **Transcriptomics**: Biological replicates and controls; Sampling methods and RNA extraction, RIN value, rRNA depletion and mRNA enrichment; Short-read vs long-read sequencing (Illumina, PacBio, ONT); RNA-seq data analysis: de-novo and reference based transcriptome assembly; Read Alignment and Quantification: RPKM, FPKM, TPM, normalization; differential expression analysis; Functional Enrichment and Pathway Analysis; Single-cell transcriptomics, TWAS.

ii. **Whole exome sequencing**: Genomic vs exomic sequencing; Exome enrichment and sequencing, Reference alignment, Variant calling and annotation, copy number variants (CNVs). Applications of WES in disease research, clinical diagnostics, and personalized medicine, Ethical considerations and societal implications of WES

iii. **Epigenomics**: Introduction to Epigenetics: DNA methylation, histone modifications, and ATP-dependent chromatin remodeling, 3D Chromatin, ChIP-seq, 5C, 4C, ATAC-seq, Bisulfite-seq, MeDIP-seq, etc, Data alignment, Peak Calling and Annotation, Differential peak analysis, Functional Interpretation and Integration, Single-Cell Epigenomics.

iv. **Genome projects**: The Human genome project, HapMap Project, The 1000 genome project, The Human Epigenome Project (HEP), The Genome India Project (GIP) and The ENCODE Project

NOTE FOR PAPER SETTING AND COURSE EVALUATION

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Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I
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External Practical/ Research (thesis/project/patent) examination

Syllabi for 1 year PG Program as per NEP 2020
M.Sc. MICROBIOLOGY
SEMESTER I

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

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Course code: P1MBTE109
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BOOKS RECOMMENDED

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

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SEMESTER I
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Course Title: MICROBIOMICS
Course code: P1MBTE110
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

COURSE OBJECTIVE:
This course aims to provide students with a comprehensive understanding of microbiomics, focusing on the composition and role of microbial communities in health, disease, and the environment. Students will learn the principles and methods used in bioinformatics analysis and microbiome profiling through lectures, case studies, and hands-on analysis.

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

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

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

UNIT - II: INTRODUCTION TO MICROBIOMICS

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

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Course Title: MICROBIOMICS
Course code: PIMBTE110
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Syllabi for 1 year PG Program as per NEP 2020
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SEMESTER I
Syllabi for the examinations to be held in the years Dec 2026, Dec 2027 & Dec. 2028

Course Title: MICROBIOMICS
Course code: P1MBTE110
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	05+ 05
TEST II (after 60days)	21 to 40%	1 hour	05+ 05
Theory	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Major test (after 90 days)	100%	2.5 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
External Examination	100%	2 hours	25
Total			50

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

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

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

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

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.

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Max. Marks: 50
Minor Test 1: 10
Minor Test 2: 10
Major Test: 30

BOOKS RECOMMENDED

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

Semester II

COURSE CODE	PAPER	CREDITS
	Core Courses	
P1MBTC201	Immunology and Immunotechnology	4
P1MBTC202	Clinical Microbiology	4
P1MBPC203	Laboratory course in Immunology and Immunotechnology	2
P1MBPC204	Laboratory course in Clinical Microbiology	2
	Electives*	
P1MBTE206	IPRs and Bioethics	2
P1MBTE207	Bio Entrepreneurship	2
P1MBTE208	Research methodology and Scientific communication	2
P1MBTE209	Functional Nutraceuticals	2
P1MBRC210	Research Project (Project presentation +Viva-Voce + Dissertation)	16
TOTAL		30

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

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

COURSE TITLE: Immunology and Immunotechnology
Course code: P1MBTC201
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

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

COURSE OBJECTIVES

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

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

UNIT - I: INTRODUCION TO THE IMMUNE SYSTEM

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

UNIT - II: HUMORAL AND CELL MEDIATED IMMUNITY

i. Regulation of immune response, Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B- and T- lymphocytes,
ii. Complement System: components of complement, complement activation, complement cascade, regulation of complement System

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Major Test: 3.0 hours

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

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

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;

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

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:

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

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Major Test: 3.0 hours

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

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

Major Test

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

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

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BOOKS RECOMMENDED

1. Kuby Immunology; 8th Edition 2023 By Jenni Punt & Sharon Stranford
2. Cellular And Molecular Immunology 10th Edition 2022 By Abul K Abbas
3. Paul's Fundamental Immunology by Martin Flajnik, Publisher: [Wolters Kluwer Health; 8th edition (19 October 2022)
4. Immunology, International 9th Edition 2020 by David Male
5. Coleman, R.M., Lombard, M.F. and Sicard, R.E.(1992).Fundamental Immunology. Wm. C. Brown publishers, USA.
6. Roitt,I., Brostoff, J. and Male, D. (1999). Immunology. Hartcourt Brace and Company, Asia Pte.Ltd.
7. Benjamini,E.,Coico,R., and Sunshine, G. (2000). Immunology – a short course. John Wiley and Sons. Inc., New York.
8. Davies,H. (1997). Introductory Immunology. Chapman and Hall, New York
9. Bratke & Myrtek (2007). Immunology : The experimenter series.Elsener Pub.
10. Wood, Peter (2008). Understanding Immunology Elseiver Pub. 2nd edition.

Syllabi for 1 year PG Program as per NEP 2020
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SEMESTER-II

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

COURSE TITLE: CLINICAL MICROBIOLOGY
Course code: P1MBTC202
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 3.0 hours

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

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

COURSE OUTCOME:

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

UNIT - I: PRINCIPLES OF CLINICAL MICROBIOLOGY

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

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

UNIT - II: MECHANISMS OF BACTERIAL AND VIRAL PATHOGENESIS

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

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Major Test: 60
Total: 100

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

UNIT - III: MICROBIAL AGENTS OF BACTERIAL AND PROTOZOAN DISEASES

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

UNIT - IV: MICROBIAL AGENTS OF VIRAL DISEASES

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

UNIT - V: LABORATORY DIAGNOSIS AND CONTROL IN INFECTIOUS DISEASES

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

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)

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

TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	I 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

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Major Test

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

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

BOOKS RECOMMENDED

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

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

Course Title: IPRs and Bioethics
Course code: P1MBTE206
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5hours

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

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

COURSE OUTCOME:

- Students will gain knowledge about the basics of the primary forms of intellectual property rights, the right of ownership, scope of protection as well as the ways to create and to extract value from IP.
- Students will able to analyze the effects of intellectual property rights on society as a whole.
- Students will able to understand different aspects of bioethical issues arises due to advancement in Microbiology.

UNIT-I: INTELLECTUAL PROPERTY

i. Introduction to IPRs; various types of IPRs: Trademarks, Copyrights, Geographical indications, Trade Secrets; Role of IPRs in Biotechnology
ii. Patents: Criteria for patenting in Biotechnology/Microbiology/Biochemistry: novelty, non-obviousness, and utility, patentable and non-patentable inventions; Biological Patents; Purpose of patents
iii. *Sui generis* system of IPRs: Need for *Sui generis* system; Plant variety protection, Database protection, other forms of *Sui generis* protection
iv. Introduction to WIPO and TRIPS, Various provisions in the TRIPS Agreement; Indian legislations for the protection of various types of IPs; National Biodiversity protection initiatives

UNIT-II: PATENT

i. Specific challenges in biological patenting: gene patents, diagnostic patents, and biopharmaceuticals.
ii. Patent application: various components of Patent Application, patent search, patent filing, Pre grant and post grant opposition, Patent Cooperation Treaty (PCT)
iii. Introduction to Indian patent office, US patent office
iv. Patent Licensing; Technology Transfer; The role of technology transfer offices in academic and research institutions; Patent Infringement

UNIT-III: BIOETHICS

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

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Minor Test 1: 10
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Major Test: 30

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	10
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Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	2 hours	25
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Minor Test 2: 10
Major Test: 30

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

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BOOKS RECOMMENDED:

1. Keswani C and Possas C (2024); Intellectual Property Issues in Life Sciences: Disputes and Controversies, CRC Press USA
2. Stasi A and David TWC (2023); An Introduction to Legal, Regulatory and Intellectual Property Rights Issues in Biotechnology, Bentham Science Publishers UAE.
3. Pattinson S; (2025) Medical Law and Ethics (7th Edition), Sweet & Maxwell Publishers, ISBN: 9780414125070
4. Goodwin M, Tu S, Paris J J. (2015) Biotechnology, Bioethics and the Law. LexisNexis
5. Kornyo E. A. (2017) A Guide to Bioethics. CRC Press, USA.
6. Ahuja VK (2015) Intellectual Property Rights in India Lexis, Nexis, and New Delhi.
7. Padma N; (2017) An introduction to Ethical, Safety and intellectual property rights issues in Biotechnology, Academic press (Elsevier), UK.
8. Singh HB, Jha A and Keswani C; (2016) Intellectual property issues in Biotechnology, CABI, UK

Syllabi for 1 year PG Program as per NEP 2020
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SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May. 2029

COURSE TITLE: Bioentrepreneurship
Course code: P1MBTE207
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

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

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

UNIT -I INTRODUCTION TO BIOENTREPRENEURSHIP
i. Overview of Bioentrepreneurship; Definition, scope, and importance of bioentrepreneurship.
ii. Integration of science, technology and business for bioentrepreneurship; creativity; innovation – types, out of box thinking
iii. Various Entrepreneurial opportunities in Biotechnology /Microbiology/ Biochemistry; New evolving areas in Biotechnology
iv. Social and business entrepreneurship; basic characteristics of entrepreneurship; Developing entrepreneurship through training and motivation

UNIT -II ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT
i. Translating scientific research into commercially viable products; IP and technology transfer from academic/research institutions
ii. Business plan preparation including statutory and legal requirements, Business feasibility study, financial management, collaborations and partnerships
iii. Assessment of market demand for potential product(s) of interest; Market conditions, segments; Identifying needs of customers including gaps in the market.
iv. Branding issues; Developing distribution channels; Pricing/Competition; Promotion/ Advertising

UNIT -III DEVELOPING A BUSINESS MODEL FOR STARTUPS
i. Development and upgradation of technology, Technology transfer, Quality control, Regulatory Compliances and procedures
ii. Concept of startups and associated challenges, stages of startups, incubation centre, acceleration centre

COURSE TITLE: Bioentrepreneurship
Course code: P1MBTE207
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

iii. Understanding the biotech venture funding lifecycle: seed money, venture capital, angel investors, government grants, and crowdfunding; Government grants Schemes like SISFS, CGSS, AIM etc., BIRAC: SEED fund, BIG etc.
iv. Startups/companies working in different areas of specialization (agri-based, pharma -based etc.); Case studies of successful biotech startups

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

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

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

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COURSE TITLE: Bioentrepreneurship
Course code: P1MBTE207
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

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

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

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

BOOKS RECOMMENDED:

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

Additional Resources:

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

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

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COURSE TITLE: Research Methodology and Scientific Communication

Course code: P1MBTE208
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

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

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

UNIT I: SCIENCE METHODOLOGIES
i. The philosophy of science; empirical science, manipulative experiments and controls
ii. Deductive and inductive reasoning, reductionist vs holistic biology
iii. Identifying a research area of interest, importance of originality and impact, exploratory versus incremental research
iv. The research process, hypothesis testing, experimental design

UNIT II: PROCESS OF COMMUNICATION
i. Concept of effective communication- setting clear goals for communication; determining outcomes and results;
ii. Initiating communication; preparing and presenting using PowerPoint; defending interrogation; scientific poster preparation & presentation;
iii. Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching;
iv. Hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

UNIT III: SCIENTIFIC COMMUNICATION
i. Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science;
ii. Problems while writing a scientific document; Software for plagiarism
iii. Scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts;

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Course code: P1MBTE208
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

iv. Publishing scientific papers - peer review process and problems, recent developments such as open access and nonblind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
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TEST II (after 60days)	21 to 40%	1 hour	5 + 5
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	30
Total			50
Practical / Research (thesis/project/patent)			
Internal Examination	100%	4 hours	25
External Examination	100%	4 hours	25
Total			50

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

Test I and Test II

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

45

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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: P1MBTE208
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

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

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BOOKS RECOMMENDED:

1. 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

Syllabi for 1 year PG Program as per NEP 2020
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SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, May 2028 & May. 2029

COURSE TITLE: Functional Nutraceuticals
Course code: P1MBTE209
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

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

COURSE OBJECTIVE:
This course explores the biochemical and molecular foundations of human nutrition, focusing on nutrient-gene interactions, metabolic regulation, clinical implications of nutrient deficiencies and excesses, and current developments in nutraceuticals and functional foods.

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

UNIT I: NUTRIENT-GENE INTERACTIONS AND NUTRITIONAL GENOMICS

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

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

i) Hormonal regulation of appetite: Ghrelin, leptin, insulin, PYY, GLP-1; Nutrient sensing pathways (e.g., SIRT1, AMPK).
ii) Hormonal control of carbohydrate, lipid, and protein metabolism (insulin, glucagon, cortisol, leptin, ghrelin), Signal transduction pathways (e.g., mTOR, AMPK, PPARs).
iii) Neuro-biochemistry of food intake and reward system (dopamine, serotonin pathways) and Eating-disorders: biochemical and metabolic consequences. Biochemical response to fasting, starvation, and refeeding syndrome.
iv) Clinical biomarkers of nutritional status (serum proteins, lipid profile, vitamin levels), Biochemical basis of malnutrition and overnutrition.

UNIT III: ADVANCED THERAPEUTIC NUTRITION OF IMMUNE AND GUT HEALTH

i) Dietary supplements: Efficacy, safety, regulatory aspects; Concept of Parenteral and enteral nutrition: Biochemical considerations in formulation and delivery.

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Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 24
Credits: 2
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Minor Test 1: 10
Minor Test 2: 10
Major Test: 30

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

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

COURSE TITLE: Functional Nutraceuticals
Course code: P1MBTE209
Duration of Examinations
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Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 24
Credits: 2
Max. Marks: 50
Minor Test 1: 10
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BOOKS RECOMMENDED:

1. Haslberger, A.G. 2022. Advances in Precision Nutrition, Personalization and Healthy Aging. Hardcover ISBN 978-3-031-10152-6, Softcover ISBN 978-3-031-10155-7.
2. Litwack, G. 2021. Human Biochemistry. Academic Press. ISBN: 9780323910538
3. Biswas, D., and Rahaman, S.O.(Eds.). 2020. Gut Microbiome and Its Impact on Health and Disease. Springer.
4. Nelson, D. L., and Cox, M. M. (2017). Lehninger Principles of Biochemistry. W.H. Freeman and Company.
5. Ferguson, L.R. 2014 (e-book 2016). Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition. CRC Press.
6. Watson, R.R., Preedy, V.R. 2015. Probiotics, Prebiotics, and Synbiotics: Bioactive Foods in Health Promotion. Academic Press. ISBN-10: 0128021896
7. Litwack, G. (Ed.). 2008. Human Biochemistry and Disease. Academic Press. ISBN 978-0-12-452815-4.
8. Kaput, J., and Rodriguez, R. L. 2006. Nutritional genomics: Discovering the path to personalized nutrition. Wiley-Interscience.

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

COURSE TITLE: Research Project
Course code: P1MBTE210 **Contact hours: 192**
Duration of Examinations **Credits: 16**
Max. Marks: 400
Dissertation: 200
Presentation and Viva: 200

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

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

- Apply academic concepts and theoretical knowledge to address real-world problems.
- Demonstrate research competencies, including literature review, data collection, data analysis, and interpretation of results.
- Draw meaningful conclusions from research findings and present them effectively.
- Communicate research outcomes clearly in written, oral, and visual formats.
- Collaborate effectively in teams, demonstrating strong interpersonal and time management skills.
- Exhibit readiness for professional roles or advanced academic research through enhanced problem-solving and self-directed learning abilities.

Scheme of Research Project and Dissertation

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

Research Work and Dissertation Writing:
1. After the allotment of supervisor, the student will carry out the proposed research work (field/lab.) and post-completion of the research work, students will write the dissertation. During the field/lab work and compilation of the dissertation, the student will work under continuous guidance of the supervisor who will maintain the regular attendance of the student.
2. Student will submit 2 hard copies of the final dissertation in the department along with a soft copy of the same.

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.

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

COURSE TITLE: Research Project
Course code: P1MBTE210 **Contact hours: 192**
Duration of Examinations **Credits: 16**
Max. Marks: 400
Dissertation: 200
Presentation and Viva: 200

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:
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

COURSE TITLE: Research Project
Course code: P1MBTE210 **Contact hours: 192**
Duration of Examinations **Credits: 16**
Max. Marks: 400
Dissertation: 200
Presentation and Viva: 200

enumerated, each point stated separately. Scope for future work should be stated lucidly in the last part of this chapter.

Chapter 6: References/Bibliography:

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

TYPE -SETTING, TEXT PROCESSING AND PRINTING

1. The text shall be printed employing using a standard text processor. The standard font shall be Times New Roman of 12 pts with 1.5 line spacing.
2. Binding Spiral or hard Binding
3. Front Covers: The front covers shall contain the following details: a. Full title of dissertation in 6 mm/22 point's size font properly centered and positioned at the top. b. Full name of the candidate in 4.5 mm 15 point's size font properly centered at the middle of the page. c. 40 mm wide replica of the College and University emblems followed by the name of department, name of the College, name of the University and the year of submission, each in a separate line and properly centered and located at the bottom of page.
4. Title Sheet: This shall be the first printed page of the thesis and shall contain the submission statement: the dissertation submitted in partial fulfilment of the requirements of the B.Sc. (Honours) Biotechnology, the name, Registration No. and University Roll No. of the candidate, name(s) of the Supervisor, Department, College, University and year of submission. 5. A Declaration of Academic Honesty and Integrity by Candidate: A declaration of Academic honesty and integrity is required to be included along with every dissertation. The format of this declaration is given in Annexure-I attached.
6. Certificate from Supervisor (Annexure-II):
7. Abstract: The 500-word (maximum) abstract shall highlight the important features of the dissertation.

Evaluation of the dissertation:

1. The project report/dissertation shall be evaluated by the external expert from other University/Institutes
2. The students shall be declared pass in the research project course if she/he secures minimum 40% marks (Dissertation and viva).

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COURSE TITLE: Research Project
Course code: P1MBTE210 **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: .....

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

COURSE TITLE: Research Project
Course code: P1MBTE210 **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