MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

(Formerly West Bengal University of Technology)

Syllabus of B.Sc. in Microbiology

SIXTH SEMESTER

Sl.	Subject Type	Code	Subject Name	Credits			Total Credits
				L	T	P	
1.	DSC	BMMC- 301	Virology	3	1	0	4
2.		BMMC-6302 BMMC-6392	Food and Industrial microbiology	3	0	2	5
3.		BMMC-6303 BMMC-6393	Agricultural Microbiology & Plant pathology	3	0	2	5
4.	DSE	MIC601	Web Development with HTML and CSS	3	1	0	4
5.		MIC602	Internet and Networking /ERP	3	1	0	4
Total Credit							22

Course Name: Virology **Code: BMMC 6301**

Credits: 4 **Total hours: 60**

Aim of the course: The primary aim of a virology course is to provide comprehensive education on the nature, biology, and significance of viruses in health, disease, and biotechnology.

Course objectives:

The objectives of a virology course are to provide students with a comprehensive understanding of virus structure, classification, and replication, as well as to explore virus-host interactions and the mechanisms by which viruses cause disease. The course aims to develop skills in laboratory methods for virus detection, diagnostics, and research, while fostering critical thinking about viral epidemiology, prevention, and the societal impact of viral infections. By the end, students should be equipped to analyze, interpret, and communicate scientific and clinical information in the field of virology.

Sl	Graduate attributes	Mapped modules
CO1	Understand the fundamental concepts of viruses including their discovery, nature, types, and structural characteristics, as well as classification and taxonomy of different virus groups.	M1
CO2	Explain the diversity, life cycles, and molecular biology of bacteriophages, with special focus on lambda phage and its genetic regulation mechanisms.	M2
CO3	Describe the various modes of viral transmission, salient features of viral nucleic acids, and replication strategies of viruses according to the Baltimore classification, including virus-host interactions and release mechanisms.	M3
CO4	Analyze the role of oncogenic viruses in cancer development and understand the molecular concepts of oncogenes and proto-oncogenes.	M4
CO5	Evaluate different strategies for prevention and control of viral diseases, including the use of antiviral drugs, interferons, and vaccination principles.	M5
CO6	Apply knowledge of virology to modern biotechnological applications such as the use of viral vectors in gene cloning, gene therapy, and phage display technology.	M6

Learning Outcome

To impart basic knowledge about the following

- Develop a clear understanding of virus biology, structure, classification, and evolution.
- Acquire the ability to describe and explain viral replication cycles and gene regulation in bacteriophages.
- Gain knowledge of different modes of viral transmission and the molecular features of viral genomes.
- Analyze virus-host interactions and mechanisms of viral entry, assembly, and release.
- Understand the role of viruses in oncogenesis and the molecular basis of viral-induced cancers.
- Learn to evaluate and apply antiviral strategies including drug action, interferons, and vaccine design.
- Develop practical skills in virological techniques such as virus isolation, cultivation, and diagnostic methods.
- Apply concepts of virology in biotechnology, including the use of viral vectors for gene therapy and molecular cloning.

- Enhance critical thinking and scientific communication skills for interpreting and discussing virological research and data.
- Foster awareness of the societal and ethical implications related to viral diseases and their control.

Module Number	Content	Total hours	% of questions	Bloom level (applicable)	Remarks, if any
THEORY					
M 1	Introduction: Discovery of viruses, nature and definition, general properties, viroids, virusoids, satellite viruses, prions, theories of viral origin, virus structure, isolation, purification, cultivation, taxonomy and classification	10	15%	1, 2	Fundamental concepts and foundation
M2	Bacteriophages: Diversity, classification, one-step multiplication curve, lytic and lysogenic phages, regulation of transcription in lambda phage	6	10%	2, 3	Emphasis on bacteriophage biology
M3	Viral Transmission: Modes of transmission, features of viral nucleic acid, replication strategies, assembly, maturation, release	20	30%	2, 3, 4	Core concepts, high weightage
M 4	Viruses and Cancer: Oncogenic viruses, types of oncogenic DNA and RNA viruses, oncogenes and proto-oncogenes	6	10%	2, 4	Important for medical relevance
M5	Prevention & Control: Antiviral compounds, interferons, vaccination principles	6	20%	2, 3	Focus on control and prevention
M6	Applications of Virology: Viral vectors in cloning & expression, gene therapy, phage display	4	15%	3, 6	Applied virology and biotechnology
Total Theory		**50**	**100**		

Detailed syllabus

Module 1:

Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses. Viral taxonomy: Classification and nomenclature of different groups of viruses

(Total Hours: 10)

Module 2:

Bacteriophages: Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

(Total Hours: 06)

Module 3:

Viral Transmission: Salient features of viral nucleic acids and Replication No. of Hours: 20 Modes of viral transmission: Persistent, non-persistent, vertical and horizontal Salient features of viral Nucleic acid : Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV) Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna), Assembly, maturation and release of virions

(Total Hours: 18)

Module 4:

Viruses and Cancer: Introduction to oncogenic viruses Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes

(Total Hours: 6)

Module 5:

Prevention & control of viral diseases: Antiviral compounds and their mode of action Interferon and their mode of action, General principles of viral vaccination

(Total Hours: 6)

Module 6:

Applications of Virology: Use of viral vectors in cloning and expression, Gene therapy and Phage display

(Total Hours: 4)

Suggested Readings

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.

2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.

3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.

4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.

5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.

6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.

7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.

8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.

9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

Course Name: Food and Industrial Microbiology **Code: BMMC6302**

Credits: 5 (3L +2T) **Total hours: 75**

Aim of the course: To acquaint students with basics of bioprocesses and their applications in pharmaceutical and other industry.

Course objectives: To impart the knowledge about different bioprocess technologies and their applications in industrial operations

Sl	Graduate attributes	Mapped modules
CO1	To acquire comprehensive knowledge of industrial microbiology and its operations	**M1**
CO2	To develop the concept of industrially important strain screening, development and downstream processing of their metabolites	**M2**
CO3	To demonstrate proficiency in production of fermented food products	**M3**
CO4	To gain analytical knowledge about various recent techniques of food preservation	**M4**
CO5	To apply the holistic knowledge of food preservation in packaging of foods by using newer techniques	**M5**
CO6	To utilize the knowledge of food safety as per national protocols in industrial production of food	**M6**

Learning outcome

The candidates should demonstrate the comprehensive knowledge and practical skills in developing process technologies for industrial production of food products, especially the fermented ones. They will be able to construct and screen industrially important microbes to get value added products from them. They should formulate processes necessary for preservation, standardization and packaging of foods.

Module Number	Content	Total hours	% of questions	Bloom level (applicable)	Remarks, if any
THEORY					
M1	Introduction to Industrial microbiology	**10**	**20%**	**2,3**	**NA**
M2	Strain development and downstream processing	**5**	**15%**	**3**	**NA**
M3	Fermented foods	**10**	**20%**	**3,4**	**NA**
M4	Food preservation	**6**	**15%**	**4**	**NA**
M5	Food packaging	**10**	**20%**	**4,5**	**NA**
M6	Food safety	**4**	**10%**	**5**	**NA**
Total Theory		**45**	**100**		

Detailed Syllabus

Module 1:

Introduction to Industrial microbiology

Brief history and developments in industrial microbiology Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations. Types of fermenters – laboratory, pilot-scale and production fermenters, Components of a typical continuously stirred tank bioreactor.

(Total hours: 10)

Module 2:

Strain development and downstream: Primary and secondary screening. Preservation and maintenance of industrial strains; Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract. Concept of upstream and downstream processing.

(Total Hours: 05)

Module 3:

Fermented foods: Microorganisms in food fermentations (dairy and non-dairy based fermented food products) and probiotics. Microorganisms in food spoilage and food borne infections.

Dairy starter cultures, fermented dairy products: yoghurt, acidophilus milk, kumiss, kefir, curds and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

(Total hours: 10)

Module 4:

Food preservation: Physical methods of food preservation: temperature (low, high, canning, drying), additives, irradiation, hydrostatic pressure, high voltage pulse, extrusion cooking, microwave processing dielectric heating, and aseptic packaging, Chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

(Total hours: 06)

Module 5:

Food packaging: Introduction to packaging, Packaging operation, package-functions and design, Principle in the development of protective packaging, Deteriorative changes in foodstuff and packaging methods for prevention, shelf life of packaged foodstuff, methods to extend shelf-life, Food containers-rigid containers, corrosion of containers (Tin plate), Flexible packaging materials and their properties, Food packaging materials and their properties, Food packages-bags, pouches, wrappers, carton and other traditional package, Biodegradable packaging.

(Total hours: 10)

Module 6:

Food safety: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking Water.

(Total Hours: 04)

Suggested Readings

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P)Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
4. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
5. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi
7. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
8. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education 4. Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's Microbiology.9th Edition. McGraw Hill Higher education
9. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
10. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
11. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
12. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
13. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
14. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.

Course Name: Lab on Food and Industrial Microbiology **Code: BMMC 6392**

Credits: 2 **Total Hours: 30**

1. Determination of the microbiological quality of milk sample by MBRT
2. Standard plate count of microbes present in milk
3. Isolation of food borne bacteria and fungi from food products
4. Alkaline phosphatase test to check the efficiency of pasteurization of milk
5. Isolation of spoilage microorganisms from spoiled vegetables/fruits
6. Isolation of spoilage microorganisms from bread

Course Name: Agriculture Microbiology & Plant Pathology **Code: BMMC 6303**

Credits: 3 **Total hours: 45**

Aim of the Course:

To provide an understanding of the role of microbes in sustainable agriculture, plant health, and disease management.

Course Objective:

To equip students with knowledge of soil microbiology, plant–microbe interactions, biofertilizers, biocontrol strategies, and plant disease management for sustainable crop production.

Sl. No.	**Course Outcome (CO)**	**Mapped Module**
CO1	To understand soil as a microbial habitat, its properties, microbial diversity, and the role in nutrient cycling and disease development.	M1
CO2	To analyze microbial activities in soil, disease development mechanisms, epidemiological concepts, and host-pathogen interactions.	M2

CO3	To gain knowledge of biofertilizers, phytostimulating microbes, PGPRs, and plant defense mechanisms including genetic and biochemical resistance.	M3
CO4	To understand agricultural biotechnology, application of biocontrol practices, GM crops, and integrated plant disease management strategies.	M4
CO5	To identify and analyze major plant diseases caused by fungi, bacteria, phytoplasmas, and viruses, including their diagnosis, epidemiology, and control.	M5

Learning Outcome

By the end of this course, students will understand the role of soil microbes in nutrient cycling, analyze plant–microbe interactions and disease epidemiology, apply biofertilizers, biocontrol and biotechnology for sustainable farming, and identify and manage major plant diseases.

Module Number	**Content**	**Total hours**	**% of Questions**	**Bloom level (applicable)**	**Remarks, if any**
THEORY					
M1	Soil Microbiome and Plant-Microbe Interactions	**9**	**20%**	**1,2**	**NA**
M2	Pathogenesis, Microbial Activities and Epidemiology	**9**	**20%**	**2,3**	**NA**
M3	Biofertilizers, Phytostimulation and Plant Resistance	**9**	**20%**	**2,3**	**NA**
M4	Agricultural Biotechnology and Biocontrol	**9**	**20%**	**2,3,4**	**NA**
M5	Case Studies of Plant Diseases	**9**	**20%**	**2,3**	**NA**
Total Theory		**45**	**100**		

Detailed Syllabus

Module 1:

Soil Microbiome and Interactions: Soil as a microbial habitat, its properties, diversity, and role in mineralization of organic (cellulose, lignin, humus) and inorganic matter (phosphate, nitrate, potassium). Concepts of plant disease, pathogenicity, symptoms, and effects of environmental factors on disease development.

(Total Hours: 09)

Module 2:

Pathogenesis, Microbial Activities and Epidemiology: Microbial activities linked to greenhouse gases, steps in pathogenesis (entry, penetration, dissemination), and environmental influence. Epidemiology concepts such as monocyclic and polycyclic diseases, disease triangle, pyramid, forecasting, and host–pathogen virulence factors.

(Total Hours: 09)

Module 3:

Biofertilizers and Plant Resistance: Plant growth-promoting microbes and biofertilizers including symbiotic and non-symbiotic forms, mycorrhizae, and PGPRs. Genetic and biochemical bases of plant resistance such as R/avr genes, structural and biochemical defenses, hypersensitive response, SAR, phytoalexins, and PR proteins.

(Total Hours: 09)

Module 4:

Biotechnology and Biocontrol: Applications of agricultural biotechnology such as biomanure, silage, biogas, and biofuels. Explores use of biocontrol agents against pathogens, insects, and weeds. GM crops like Bt and Golden rice along with integrated disease management strategies—regulatory, cultural, chemical, and biological measures including bioinsecticides and bioherbicides.

(Total Hours: 09)

Module 5:

Case Studies of Plant Diseases: Fungal, bacterial, phytoplasma, and viral diseases with examples such as late blight of potato, rusts and smuts of wheat, red rot and blast of rice, citrus canker, aster yellows, rice tungro virus and TMV, emphasizing their symptoms, epidemiology, and control measures.

(Total Hours: 09)

Suggested readings

1. Verma D.K. (Ed.). Microbiology for Sustainable Agriculture, Soil Health, and Environmental Protection. Taylor & Francis, 2019

2. Satish Serial Publications. Sustainable Agriculture and Soil Health. 2023

3. Dixon, G.R., & Tilston, E.L. Soil Microbiology and Sustainable Crop Production. Academic Press, 2018

4. Reddy, S.M. Bioinoculants for Sustainable Agriculture and Forestry. Springer, 20155. Paul, E.A. Soil Microbiology, Ecology and Biochemistry. Academic Press, 2014

Course Name: Lab on Agriculture Microbiology & Plant Pathology **Code: BMMC 6393**

Credits: 2 **Total Hours: 30**

1. Study of soil profile
2. Study microflora of different types of soils
3. *Rhizobium* as soil inoculants characteristics and field application
4. *Azotobacte*r as soil inoculants characteristics and field application
5. Isolation of cellulose degrading organisms
6. Enumeration of fungal population in soil.
7. Isolation of Blue Green Algae (BGA)
8. Demonstration of Koch's postulates.
9. Isolation and cultivation of plant pathogens from different diseased plant parts

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