

J.C. Bose University of Science & Technology, YMCA Faridabad

(NAAC Accredited “A” Grade University of State Govt. established by Haryana State Legislative Act No.21 of 2009)

**Department of Life Sciences
(w.e.f.2021)**



**Syllabi for
M.Sc.
Microbiology
(Semester III and IV)**

PROGRAM OUTCOMES OF PG PROGRAM OF FACULTY OF SCIENCES

PO1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO2	Research Aptitude	Capability to ask relevant/appropriate questions for identifying, formulating and analyzing the research problems and to draw conclusion from the analysis
PO3	Communication	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large
PO4	Problem Solving	Capability of applying knowledge to solve scientific and other problems
PO5	Individual and Team Work	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO6	Investigation of Problems	Ability of critical thinking, analytical reasoning and research-based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO7	Modern Tool usage	Ability to use and learn techniques, skills and modern tools for scientific practices
PO8	Science and Society	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices
PO9	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life
PO10	Ethics	Capability to identify and apply ethical issues related to one's work, avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work
PO11	Project Management	Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects

PROGRAM SPECIFIC OUTCOMES (PSOs)

The program specific outcomes (PSO's) are the statement of competencies/abilities that describes the knowledge and capabilities of the post-graduate will have by the end of program studies.

After successful completion of M. Sc. Microbiology, the students will be able to

PSO1	The detailed functional knowledge of theoretical concepts and experimental aspects of microbiology.
PSO2	To integrate the gained knowledge with various contemporary and evolving areas in microbial sciences with the knowledge to handle microbes and basic instrumentation used in microbiological laboratory.
PSO3	To understand, analyze, plan and implement qualitative as well as quantitative knowledge of various basic techniques to isolate, characterize the microbes. The course will help them to impart the knowledge of the basic principles of bacteriology, virology, mycology, immunology and parasitology including the nature of pathogenic microorganisms, pathogenesis, laboratory diagnosis, transmission, prevention and control of diseases common in the country
PSO4	Provide opportunities to excel in academics, research or Industry.

SEMESTER-III										
Sr. No.	Course Code	Subject	Teaching Hours per week			Maximum Marks			Credits	Category Code
			L	T	P	Int	Ext	Total		
1	MMT-301	Industrial Microbiology	4			25	75	100	4	DCC
2	MMT-302	Medical Microbiology	4			25	75	100	4	DCC
3	MMT-303	Immunology	4			25	75	100	4	DCC
4	MMT-304	Genetics	4			25	75	100	4	DCC
5	MMT-305	Lab Course- I (Based on MMT 301-302)			6	30	70	100	3	DCC
6	MMT-306	Lab Course- II (Based on MMT 303- 304)			6	30	70	100	3	DCC
7	MMT-307	Seminar						25	1	DCC
8	XXX	*Open Elective Course	3	0	0	25	75	100	3	OEC
Total								725	26	

DCC- Discipline core course
***OEC – Open Elective Course-** The students have to choose one Open elective course related to another branch of Science/Engg. /other discipline required for enhancing professional performance as provided by the department/university-
OES-301A- Waste Management in Daily Life
OES-302A- Environmental Conservation
OCH 307A- Chemistry for sustainable Development
L – Lecture; T-Tutorial, P – Practical

SEMESTER-IV										
Sr. No.	Course Code	Subject	Teaching Hours per week			Maximum Marks			Credits	Category Code
			L	T	P	Int	Ext	Total		
1	MMT-401	Food Microbiology	4			25	75	100	4	DCC
2	MMT-402	Environmental and Agricultural Microbiology	4			25	75	100	4	DCC
3	MMT-403	Plant Pathogen Interaction	4			25	75	100	4	DCC
4	MMT-404	Lab Course-I (Based on MMT 401)			6	30	70	100	3	DCC
5	MMT-405	Lab Course-II (Based on MMT 402-403)			6	30	70	100	3	DCC
6	MMT-406	Project Report			12	-	-	100	6	
Total								600	24	

Course Code: MMT-301
Subject: Industrial Microbiology
No. of credits: 4
L P
4 0

Maximum Marks: 100
Theory exam: 75
Sessional: 25

Course Objectives: To introduce and understand the concept of industrial microbiology. Screening of metabolites. Strain development and maintenance of industrially important microorganism. Fermentation- its types and different components. Production of fermented beverages and fermentation processes involved in the production of antibiotics etc.

UNIT I

Introduction to Industrial microbiology. Screening for new metabolites - primary and secondary metabolites. Strain development through selection, mutation, recombination and other genetic and biochemical methods. Maintenance of industrially important microorganisms.

UNIT II

Fermentation- Batch, Continuous and Synchronous. Substrates for fermentations- types and availability. Different components of Fermenter, Bioreactors, Design and working of a typical bioreactor (aeriation, agitation and control). Downstream processing Introduction to immobilization technology.

UNIT III

Fermented beverages like wine, beer. Production of alcohol (ethanol), wine, beer, sauerkraut, organic acid (citric acid, lactic acid), amino acid (lysine, glutamic acid), nucleotides and related compounds. Production of enzymes. Michalis-Menton Equation. Protease and amylase production.

UNIT IV

Fermentation process involved in antibiotics (streptomycin, tetracycline, penicillin), hormones, vitamins, steroid production. Synthesis of commercial products by recombinant microorganisms, biopolymers, human insulin, growth hormones, interferon and vaccines.

Suggested Readings:

- Reed G (2004) Prescott and Dunn's Industrial Microbiology. CBS Publishers & Distributors. 4th edition.
- Glazer AN and Nikaido H (2007) Microbial biotechnology: Fundamentals of Applied Microbiology. Cambridge University Press. 2nd edition.
- Willey JM and Guthart LA (2016) Prescott's Microbiology. McGraw-Hill Education. 10th edition.
- Stanbury P, Whitaker A, and Hall S (2016) Principles of Fermentation Technology. Butterworth-Heinemann. 3rd edition.
- Waites MJ, Morgan NL, Rockey JS, and Higton G (2013) Industrial Microbiology: An introduction. Wiley-Blackwell. 1st edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Understood knowledge of bioprocess technology- upstream and downstream processing of major bioproducts.

CO2- Learnt various processes involved in strain development as well as maintenance of industrially important microorganisms.

CO3- Understood the operation, structure, and functions of various bioreactors.

CO4- Understood the role of bioprocessing for the production new drugs and vaccines.

Mapping of CO and PO for MMT-301

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3
CO3	3	3	3	2	3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	2	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT-302
Subject: Medical Microbiology
No. of credits: 4
L P
4 0

Maximum Marks: 100
Theory exam: 75
Sessional: 25

Course Objectives: To introduce and understand the concept of medical microbiology, normal microflora of human body, pathogenicity and epidemiology of infectious diseases, bacterial diseases spread, bacterial zoonoses and biosafety practices in biological sciences.

UNIT I

Introduction to medical microbiology and medically important microorganisms; normal microflora of Human body. Collection, transportation and examination of pathologic specimens. Isolation and identification of pathogenic organism.

UNIT II

Pathogenicity: virulence factors, microbial adherence, spreading and establishment of pathogens. Bacterial toxins-their types. Epidemiology of infection diseases. Food poisoning and Food infections.

UNIT III

Brief account of bacterial diseases spread through air (diphtheria and tuberculosis), food and water (typhoid, cholera, and dysentery), soil (anthrax, tetanus, and gas gangrene) and contact (leprosy, and conjunctivitis). Bacterial zoonoses (bubonic plague and salmonellosis) and protozoal diseases (malaria).

UNIT IV

Nosocomial and emerging microbial infection diseases. Biosafety practices in biological sciences and disposal of biomedical waste. Bio-terrorism. Biological war. Etiology. Epidemiology. Pathogenesis. Symptomology. Pathology. Disease diagnosis and treatment of fungal diseases: Candidiasis, Histoplasmosis, Aspergillosis, Cryptococcosis, and Dermatormycosis. Different types of techniques for diagnostic of corona. Antimicrobial resistance.

Suggested Readings:

- Murray PR, Rosenthal KS, Kobayashi GS and Pfaller MA (2020) Medical Microbiology. Elsevier. 9th edition.
- Sastry A and Bhat S (2018) Essentials of Medical Microbiology. Jaypee Brothers 2nd edition.
- Sastry A and Bhat S (2018) Review of Microbiology & Immunology. Jaypee Brothers 7th edition.
- Cruikshank R (1965) Medical Microbiology. Churchill Living stone Pub. 11th edition.
- Volk WA, Gebhardt BM, Hammarskjold ML and Kadner R (1995) Essentials of Medical Microbiology. Lippincott Williams and Wilkins. 5th edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Learn the concepts of medical microbiology.

CO2- Understood the pathogenicity and epidemiology of infectious diseases.

CO3- Understood the brief account of bacterial disease spread and protozoal diseases.

CO4- Understood the importance and level of biosafety at laboratory and industrial levels.

Mapping of CO and PO for MMT–302

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO3	3	3	3	2	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT-303

Subject: Immunology

No. of credits: 4

L P

4 0

Maximum Marks: 100

Theory exam: 75

Sessional: 25

Course Objectives: This course includes a detailed description of the immune response made in humans to foreign antigens including microbial pathogens. A description of cells involved in the immune response either innate or acquired. How the immune system recognizes self from non-self. B and T cell maturation and specific responses.

Unit I

Cells and organs of immune system. Primary, secondary and tertiary lymphoid organs. Types of immunity - Innate and adaptive, Humoral and cell-mediated, Active and passive, PAMP: TLR, Clonal selection theory. Immunological memory, Antigens and immunogens, B and T cell epitopes; Haptens. Structure and functions of antibodies. Classes of immunoglobulins. CDRs, Valence, affinity and avidity. Antibody variants - Isotypes, Allotypes and Idiotypes.

Unit II

The immunoglobulin genes: organization and assembly; generation of immunological diversity; Allelic exclusion. Major histocompatibility complex (MHC): structure and organization of MHC. Antigen processing and antigen presentation. T cell Receptor: Superantigens. B cell activation and maturation. T cell development and activation. Cytotoxic T cell mediated killing. Complement system and mechanism of its fixation. Complement deficiencies. V(D)Jrecombination, somatic hypermutation and class switch recombination of immunoglobulins: mechanism and regulation.

Unit III

Immunological tolerance. Autoimmunity and associated disorders. Allergy and hypersensitivity, types of Hypersensitivity. Transplantation immunology - Graft rejection, graft versus host reaction. Immune response to infectious diseases – viral, bacterial, protozoal. Immunosuppression - immunodeficiency diseases. Communicative Viral Diseases.

Unit IV

Role of cytokines, lymphokines and chemokines. Vaccine and its different types. Different types of Vaccines for COVID-19. Hybridoma Technology: Production of murine monoclonal antibodies (MoAbs)-Fusion strategies, HAT Selection; Strategies for production of human MoAbs- Humanization and antigenization of MoAbs-Chimeric, CDR-grafted

Suggested Readings:

- Punt J, Stranford SA, Jones PP, and Judith AO (2019) Kuby immunology. WH Freeman. 8th edition.
- Abbas AK, Lichtman AH, and Pillai S (2016) Cellular and Molecular Immunology. Saunders. 9th edition.
- Male DK, Brostoff J, Roth D, and Ivan R (2012) Immunology. Gower Medical Publishing London. 8th edition.
- Gupta SK (2010) Essentials of Immunology. Arya Publication. 2nd edition.
- Khan FH (2009) The Elements of Immunology. Pearson Education India. 1st edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Understood the concept of innate and adaptive immunity.

CO2- Understood the various mechanisms that regulate immune responses and maintain tolerance.

CO3- Elucidated the reasons for immunization and awareness of different vaccination.

CO4- Understood the stages of transplantation response and success of various transplant procedures.

Mapping of CO and PO for MMT-303

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	1	2	3	3	2	3	2	3	2	3	3	3
CO2	3	3	3	3	3	3	2	3	2	2	3	2	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2	2	3
CO4	3	3	3	3	2	3	2	3	3	2	3	3	2	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT-304

Subject: Genetics

No. of credits: 4

L P

4 0

Maximum Marks: 100

Theory exam: 75

Sessional: 25

Course Objectives: To develop and demonstrate an understanding of the structure and function of genes and the organization of the human genome; the patterns of inheritance and clinical manifestations of genetic diseases; chromosomes, chromosomal abnormalities, and the clinical features of common chromosomal disorders.

Unit I

Mendelian vs. Non-Mendelian inheritance, monohybrid and dihybrid crosses, Mendelian Principles-Dominance, Segregation and Independent assortment. Extensions of Mendelian principles: Codominance, Incomplete dominance, Multiple Allelism. Gene interactions-Epistasis, Collaboratory gene action, Duplicate genes, Complementary Gene action, Complementation Test. Pleiotropy. Phenocopy. Probability and Pedigree analysis. Sex limited and sex influenced characters. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL. Extrachromosomal Inheritance, Maternal effect.

Unit II

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Linkage maps, recombination, tetrad analysis (Ordered and unordered Tetrad analysis), mapping with molecular markers, mapping by using somatic cell hybrids. Linkage Group

Unit III

Cytogenetics: Chromosome: structure and nomenclature, centromere and telomere; Structural and numerical alterations of chromosomes: Deletion, duplication, Pericentric and Paracentric inversion, Inversion heterozygotes, Inversion homozygotes. Reciprocal and nonreciprocal translocation, Homozygotes as well as Heterozygote Trans locants. Ploidy (Aneuploidy and Euploidy) and their genetic implications.

Unit IV

Mutation: Types, causes and detection, mutant types – lethal, conditional, Base substitution and frame shift Mutation. Biochemical, loss of function, Gain of function, Germinal versus Somatic mutants, Ames Test.

Epigenetics: Introduction, methylation, histone modifications.

Allele frequency, Gene Frequency, Hardy Weinberg Equilibrium

Suggested Readings:

- Gardner EJ (2005) Principles of Genetics. John Wiley & Sons Ltd. 8th edition.
- Tamarin RH (2017) Principles of Genetics. Tata McGraw-Hill Publishing Comp. Ltd. 7th edition.
- Pierce BA (2016) Genetics – A conceptual approach. WH Freeman Company. 6th edition.
- Snustad DP and Simmons MJ (2015) Principles of Genetics. John Wiley and Sons. 7th edition.
- Hartl and Jones (2017) Genetics-Principles and Analysis. Jones & Bartlett. 9th edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Understood the building block for genetics i.e. life cycles of model organisms, basic genetic experiments, polyploidy, and QTL.

CO2- Learn the organization of genome and specialized chromosomes, chromosomal theory of inheritance, linkage, inheritance modes in nature, maternal inheritance, crossing over, and recombination.

CO3- Understood the important hereditary diseases, their inheritance patterns, and pedigree analysis

CO4- Understood the significance and impact of mutations.

Mapping of CO and PO for MMT-304

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	2	3	3	3	3	3	2	3	3
CO2	3	3	2	3	2	3	2	3	3	2	3	2	3	3	3
CO3	3	3	2	3	2	3	2	3	3	3	3	3	2	3	3
CO4	3	3	3	3	2	3	2	3	3	3	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT 305

Subject: Lab Course - I (Based on MMT 301–302)

Number of Credits: 3

L P
0 6

1. To study the basis equipment's and other requirements in microbiology lab, their principles and working: Microscope, Autoclave, Laminar Flow Bench, Hot air Over, Incubator, Centrifuge, pH meter, and Spectrophotometer etc.
2. To perform microbial staining techniques (Concept of dyes):
 - i. Simple direct staining technique
 - ii. Negative staining technique (Capsule staining)
 - iii. Differential staining technique-Gram staining technique
3. To prepare culture media-liquid and solid for microbes; preparation of slant, gradient plate, and deep tubes (concept of nutrition).
4. To perform biochemical characterization of microorganisms (Catalase and Oxidase).
5. To perform IMVIC test from the provided bacteria samples.
6. To isolate protease, amylase, and lipase producing strains.
7. To perform efficiency assessment of PGPR (Production of HCN, ammonia, phosphate solubilization antibiotic, and IAA).
8. To perform whole cell and enzyme immobilization.
9. To perform production of alcohol from molasses/cane sugar.
10. To perform production of vinegar.
11. To check the antifungal activity of microbes by dual culture technique.
12. To isolate cellulose producing strains from natural environment.
13. To demonstrate wine production using grape juice.
14. To perform the cultivation of edible mushroom from the provided spawns.

Virtual Labs:

<https://www.vlab.co.in>

www.vlab.iitb.ac.in/vlab

www.onlinelabs.in www.powershow.com

<https://vlab.amrita.edu>

<https://sites.dartmouth.edu>

**A minimum of eight practical's should be done from the above-mentioned list.*

*** Addition or deletion of the lab experiments can be done as per the availability of resources in lab.*

Skills developed:

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

CO1- Understood the basis equipment's and other requirements in microbiology lab, their principles, and working.

CO2- Understood different microbial staining techniques, method of preparation of different culture media, and efficiency assessment of PGPR.

CO3- Performed cell and enzyme immobilization technique, produced alcoholic beverages, and isolated cellulose producing strain.

Mapping of CO and PO for MMT-305

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	2	3	3	3
CO2	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT-306

Subject: Lab Course-II (Based on MMT 303-304)

No. of Credits-3

L P

0 6

1. To perform experiment using ammonium sulphate precipitation of antibodies in serum.
2. To perform experiment on the preparation of antigen -adjuvant (FCA) emulsion.
3. To perform experiment on the collection of blood from mice and separation of serum.
4. To perform experiment on antibody purification from the serum collected from immunized mice: affinity purification/chromatography.
5. To perform experiment on double diffusion and Immune-electrophoresis
6. To perform experiment on radial immune diffusion
7. To perform experiment of Band analysis of different types of plasma antibodies by SDS PAGE
8. To perform agglutination Reaction: a) Tube Agglutination Reaction b) Slide Agglutination Reaction c) Indirect Agglutination Inhibition Reaction
9. To perform experiment for Identification of histological slides of lymphoid tissue - Spleen, thymus, lymph node and bone marrow
10. To perform experiment of Mitosis - Onion root tip squash preparation- Preparation of Karyotypes, Determination of Mitotic index.
11. To perform experiment on Mendelian Inheritance and gene interactions using suitable examples/ seeds
12. To perform experiment on study of Linkage, Recombination, gene mapping using the available data
13. To perform experiment of centromere mapping by tetrad analysis
14. Analysis of pattern of inheritance of given pedigree.
15. Calculation of recombination frequency
16. To perform experiment on Bacterial gene mapping by interrupted conjugation method
17. Calculation of co-transformation and co-transduction frequency
18. Calculation of deviation in phenotypic ratios of different intergenic gene interactions
19. To perform experiment on comparison of ploidy level with respect to given example.

**A minimum of eight practical's should be done from the above-mentioned list.*

** Addition or deletion of the lab experiments can be done as per the availability of resources in lab.*

Skill Developed-

At the end of laboratory course, learners-

CO 1- understood the basic Immunological aspects to be performed in the laboratory.

CO 2- learnt to analyze genetic problems and will be able to approach a research problem statistically.

CO 3-understood the centromere mapping as well as to calculate phenotypic ratios of different gene interactions

Mapping of CO and PO for MMT–305

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3
CO2	3	3	2	3	3	3	3	3	3	3	3	2	2	3	3
CO3	3	3	3	3	3	3	2	2	3	2	2	3	2	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Seminar:

Seminar will be of 30-45minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members/student advisors well in advance so that the same may be displayed on the notice board. The presenter has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.



J. C. Bose University of Science and Technology, YMCA, Faridabad

(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22)

Accredited 'A' Grade by NAAC

DEPARTMENT OF LIFE SCIENCES

Program M.Sc. (Microbiology)

Mapping of the Courses with the Employability/Entrepreneurship/Skill Development

M.Sc. Microbiology III (Program Code: 758)

Sr. No.	Course Code	Course Name	Employability	Entrepreneurship	Skill Development
1	MMT-301	Industrial Microbiology	√	√	√
2	MMT-302	Medical Microbiology	√	√	√
3	MMT-303	Immunology	√		√
4	MMT-304	Genetics	√		√
5	MMT-305	Lab Course I (based on MMT 301 -302)	√	√	√
6	MMT-306	Lab Course II (based on MMT 303 -304)	√	√	√
7	MMT-307	Seminar	√	√	√
8	XXX	OEC	√		√

SEMESTER-IV

Sr. No.	Course Code	Subject	Teaching Hours per week			Maximum Marks			Credits	Category Code
			L	T	P	Int	Ext	Total		
1	MMT-401	Food Microbiology	4			25	75	100	4	DCC
2	MMT-402	Environmental and Agricultural Microbiology	4			25	75	100	4	DCC
3	MMT-403	Plant Pathogen Interaction	4			25	75	100	4	DCC
4	MMT-404	Lab Course-I (Based on MMT 401)			6	30	70	100	3	DCC
5	MMT-405	Lab Course-II (Based on MMT 402-403)			6	30	70	100	3	DCC
6	MMT-406	Project Report	0	0	10	-	-	100	6	
Total								600	24	

Course Code: MMT-401
Subject: Food Microbiology
No. of credits: 4
L P
4 0

Maximum Marks: 100
Theory exam: 75
Sessional: 25

Course Objectives: To understand the concept of food microbiology, milk microbiology, bio preservation and food safety legislations, food borne infections and intoxications, and applications of microbes for different types of food production.

Unit I

Historical development and applications of food microbiology. Major food-born outbreaks in past. Microorganisms (bacteria, molds, yeast, and viruses) in food microbiology. Food safety, Food safety objectives (FSO). Food legislation: Enforcement and Govt. Regulatory practices and policies. FDA, EPA, HACCP, FSA, FSSAI act.

Unit II

Fermented and non-fermented milk products. Microbiological examination of milk and milk products. Legal standards for milk and milk products. Starter culture (Dairy and Meat Industry). Fermented meat, beef and poultry products. Microbiology of lactic cultures. Dairy products and their manufacturing. Plant-based products. Food beverages. Microbial spoilage of different foods.

Unit III

Different methods of food preservation: Freezing, Dehydration, Lyophilization, Temperature, filtration and use of chemical preservatives. Food borne infections. Bacterial food poisoning (*Staphylococcus*, *Bacillus*, *Escherichia coli*, *Vibrio cholera*, *Clostridium* etc.). Fungal food poisoning (*Aspergillus*, *Penicillium*, *Fusarium* etc.). Protozoan food poisoning (*Antamoeba* and *Giardia* etc.).

Unit IV

Microorganisms as food: Single cell protein, algae as food, and mycoprotein from fungi for use as food and feed. Industrially used SCP. Advantages of SCP. Mushroom production and its applications. Fruit and vegetable processing. Nutraceuticals: Probiotics and Prebiotics. Genetically engineered food products. Detection of microorganisms in food- conventional methods and Recent Methods . Food safety and Food security.

Suggested Readings:

- Garbult J (1997) Essentials of Food Microbiology. Arnold International Students. 2nd edition.
- Aneja KR, Pranay J, and Raman A (2008) A Text-book of Basic and Applied Microbiology. New Age International Publishers. 1st edition.
- Aneja KR and Mehrotra RS (2011) Fungal Diversity & Biotechnology. New Age International Publishers. 1st edition.
- Adams MR and Moss MO (2007) Food Microbiology. Royal Society of Chemistry Publication Cambridge. 3rd edition.
- Frazier WC and Westhoff DC (1998) Food Microbiology. Tata McGraw Hill Publishing Company Ltd. 18th Edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Understood the concepts of food microbiology.

CO2- Understood the concept of food safety objectives, regulatory practices, and policies.

CO3- Understood the brief account of food-borne infections and preservation methods.

CO4- Understood the applications of food microbiology.

Mapping of CO and PO for MMT-401

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	2	3	3	3	2	3	3	3	3
CO2	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT-402
Subject: Environmental and Agricultural Microbiology
No. of credits: 4
L P
4 0

Maximum Marks: 100
Theory exam:-75
Sessional: 25

Course Objectives: The main goal of this course is to introduce the concept of microbial diversity with reference to the environmental aspects. Student will learn about the basic microbiological principles, the methods used in microbial ecology for solid and liquid treatments and their practical applications.

Unit I

Basics of Environmental Microbiology. Microbial diversity in terrestrial, aquatic, atmospheric, stratosphere, and animals. Microbial diversity in extreme environment: thermophiles, psychrophiles, oligotrophs, alkaliphiles, acidophiles, and metallophiles etc. Microbial ecology of Soil.

Unit II

Microbiology of degradation of Xenobiotics in Environment Ecological considerations, decay behavior & degradative plasmids. Hydrocarbons, substituted hydrocarbons, oil, pollution, surfactants, pesticides, Bioremediation of contaminated soils and waste land. Biopesticides in integrated pest management. Solid wastes; sources and management (composting wormiculture and methane production). Lignin degradation: Lignocellulolytic microorganism and their biotechnological applications.

Unit III

Bioformulations: Biofertilizers and Biopesticides (Bacillus and Trichoderma). Mass cultivation of microbial inoculants; green manuring; Microbial products and plant health: PGPR (plant growth promoting rhizobacteria).

Microbial Diversity Identification from Rhizosphere: Molecular methods of identification-DGGE, TGGE, T-RFLP, 16sDNA gene sequencing, Metagenomics and RNA sequencing. Microbial communication system; Quorum sensing

Unit IV

Eco physiological interactions in microbes & higher plants- Interaction with plant roots, interaction with aerial plant structures microbial diseases of plant with specific examples of mycorrhiza, Lichens, Rhizobacteria. Phosphate solubilizing bacteria and fungi (including mycorrhiza), potassium solubilizing bacteria and fungi (including mycorrhiza).

Suggested Readings:

- Atlas RM and Bartha R (1993) Microbial Ecology: Fundamentals and Applications. Benjamin Cummings Publishing Co. 3rd Edition.
- Varnam AH and Evans MG (2000) Environmental Microbiology. Manson Publishing Ltd. 1st edition.
- Christon JH, Ronald L, Garland JL, Lipson DA, Aaron LM, and Stetzenbach LD (2007) Manual of Environmental Microbiology. Wiley-Blackwell. 3rd edition.
- Grant WD and Long PE (1981) Environmental Microbiology. Springer US. 1st edition.
- Mitchel R and Ji-Dong G (2009) Environmental Microbiology. Wiley-Blackwell. 2nd

edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Understood the diverse roles of microorganisms in natural environments and their relationship.

CO2- Understood the processes involved in treatment of waste water.

CO3- Acquired knowledge of bioremediation and its related applications.

CO4- Understood the extreme habitats in which organisms survive.

Mapping of CO and PO for MMT–402

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	2	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT-403
Subject: Plant-Pathogen Interactions
No. of credits: 4
L P
4 0

Maximum Marks: 100
Theory exam: 75
Sessional: 25

Course Objectives: Students will get basic knowledge about the subject of plant pathology, its concepts, and principles. To acquaint with different strategies for managing plant diseases.

Unit I

Introduction to the concept of plant pathogen interaction. Effect of microbial infections (bacterial, fungal and viral) on plant physiology of crops with special focus on cereal crops (rice and wheat), pulse crop (soybean and pigeonpea), cash crops (cotton and sugarcane), and oilseed crop (mustard and sunflower).

Unit II

Host parasite interaction. Recognition concept and infection. Symptomatology. Disease development- role of enzymes, toxins, growth regulators. Defense strategies- oxidative burst; Phenolics, Phytoalexins, Pathogenesis Related (PR) proteins, and Elicitors. Altered plant metabolism as affected by plant pathogens.

Unit III

Biological control of plant pathogen using bacteria, fungi and viruses. *B. thuringiensis* as microbial pesticides. Nuclear polyhedrosis virus as pesticides and concept of mycopesticides. *Trichoderma* as biopesticides. Cell wall degrading enzymes. Siderophores, Biosurfactants, Mycoparasitism, Nematophagy, and Mycophagy.

Unit IV

History and important milestones in disease control. Disease forecasting and its relevance in Indian farming. Commercial production of antagonistic bacteria, their delivery systems, application and monitoring. Biological control in integrated disease management (IDM) and organic farming system. Biopesticides available in market. Quality control system of biocontrol agents. Marketing strategies of biopesticides.

Suggested Readings:

- George NA (1969) Plant pathology. Academic Press. 5th edition.
- Mehrotra RS and Agrawal A (2017) Plant Pathology. McGraw-Hill Education. 3rd edition.
- Mehrotra RS and Agrawal A (2017) Fundamentals of Plant Pathology. McGraw-Hill Education. 1st edition.
- Sigeo DC (2014) Bacterial Plant Pathology: Cell and Molecular Aspects. Prashant Book Agency. 1st edition.
- Basu AN and Giri BK (1993) The essentials of Viruses, Vectors and Plant diseases. Wiley Eastern Limited. 1st edition.

Course Outcomes:

After completion of the course the learners will be able to:

CO1- Developed detail insight on the relationship between plant-pathogen interactions.

CO2- Understood the diverse mechanisms opted by microbes for biological control of plant pathogens

CO3- Understood the role of disease forecasting helping in detecting pathogenesis.

CO4- Developed a scientific understanding regarding bacteria, fungal, and viral infections of plants.

Mapping of CO and PO for MMT-403

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	2	3	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	2	3	3	2	2	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Course Code: MMT 404

Subject: Lab Course - I (Based on MMT 401)

Number of Credits: 3

L P
0 6

1. To perform preparation and sterilization of culture media: Nutrient agar, Potato dextrose agar (PDA) etc.
2. To perform different isolation techniques:
 - i. Pour plate
 - ii. Spread plate
 - iii. Streak plate
3. To perform microbiological analysis of food products.
4. To perform enzymatic test of milk by methylene blue reductase test.
5. To isolate clinically important microorganisms from samples.
6. To perform characterization of microorganisms: Culture characteristics and staining.
7. To study effect of UV radiations on the micro-organisms.
8. To perform Antibiotic susceptibility tests by disc diffusion and well diffusion method.
9. To perform determination of minimal inhibitory concentration (MIC) and MBC.
10. To perform isolation of microflora from human skin.
11. To perform isolation of microflora from human throat.
12. To check beta hemolysis on blood agar medium.

**A minimum of eight practical's should be done from the above-mentioned list.*

*** Addition or deletion of the lab experiments can be done as per the availability of resources in lab.*

Course Outcomes:

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

CO1- Understood the preparation and sterilization of culture media and different isolation techniques.

CO2- Understood methods for the characterization of clinically important microorganisms, their characteristics, and staining techniques.

CO3- Understood antibiotic susceptibility test, minimum inhibitory concentration, and well diffusion method.

Mapping of CO and PO for MMT-404

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	2	2	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3

****Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)**

Course Code: MMT 405

Subject: Lab Course - II (Based on MMT 402-403)

Number of Credits: 3

L P

0 6

1. To perform detection of dissolved oxygen of water.
2. To perform determination of BOD from given water sample.
3. To perform determination of total dissolved solids of water.
4. To perform determination of COD from provided water sample.
5. To perform presumptive test for coliform bacteria.
6. To perform confirmed and completed test for coliform bacteria.
7. To perform detection of Coliform and *E. coli* from sewage sample.
8. To perform construction of Winogradsky column for monitoring gradients of microorganism (chemotrophs).
9. To perform the growth kinetics experiment of the provided bacterial samples using spectrophotometer.
10. To perform isolation of aquatic plant pathogen by baiting technique.

**A minimum of eight practical's should be done from the above-mentioned list.*

*** Addition or deletion of the lab experiments can be done as per the availability of resources in lab.*

Course Outcomes:

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

CO1- Understood different biochemical parameters used for estimating water quality of samples.

CO2- Learn different techniques for isolating various plant pathogens.

CO3- Understood different physiochemical analysis used nowadays for detection of coliforms.

Mapping of CO and PO for MMT-405

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3

****Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)**

Course Code: MMT-406

Subject: Project Report

No. of credits: 6

Course Objectives:

The objective of this course is to provide students with a hands-on training in specialized area of sciences.

Contents:

- The student will be reading and analysing the published information in the chosen area of science under direct mentoring of a faculty member and will participate in research activity.
- Preparation and submission of Review article.

Course Learning Outcomes:

Students will acquire the following:

- Knowledge on techniques and tools of research.
- Quantitative and qualitative data analysis.
- Analysis and interpretation of data in the perspective of existing knowledge.



J. C. Bose University of Science and Technology, YMCA, Faridabad

(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22)

Accredited 'A' Grade by NAAC

DEPARTMENT OF LIFE SCIENCES

Program M.Sc. (Microbiology)

Mapping of the Courses with the Employability/Entrepreneurship/Skill Development

M.Sc. Microbiology IV (Program Code: 758)

Sr. No.	Course Code	Course Name	Employability	Entrepreneurship	Skill Development
1.	MMT- 401	Food Microbiology	√	√	√
2.	MMT- 402	Environmental and Agricultural Microbiology	√	√	√
3.	MMT-403	Plant Pathogen Interaction	√		√
4.	MMT-404	Lab Course I (based on MMT 401)	√	√	√
5.	MMT-405	Lab Course II (based on MMT 402)	√	√	√
6.	MMT-406	Project Report	√	√	√

