A Documentary Support

for

Matric No. – 1.1.2

employability/ entrepreneurship/ skill development

under the

Criteria – I

(Curriculum Design and Development)

Key Indicator - 1.1

in

Matric No. – 1.1.2

MASTER OF SCIENCE (MICROBIOLOGY)

1998

4. SKILL, ENTEPEUNERSHIP, EMPLOYABILTY

Registrar
Dr. B.R.A. University, Agra

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Choice Based Credit System (CBCS)
Department of Microbiology,
School of Life Sciences,
Dr. B. R. Ambedkar University, Agra

M.Sc. Microbiology I semester

Core Courses	Course Title	Marks		Total 100	Credit
		CIE	End Semester Examination		
MB -C101	Mycology	25	75	100	4
MB -C102	Virology	25	75	100	4
MB-C103	Bacteriology	25	75	100	4
MB-C104	Microbial Biochemistry and Basic Enzymology	25	75	100	4
MB-105	Practical		100	100	4
	Industrial training/Survey/Research Project				
	Total			**500**	**20**

II semester

Core Courses	Course Title	Marks		Total	Credit
		CIE	End Semester Examination		
MB-C201	Molecular Biology	25	75	100	4
MB -C202	Microbial Genetics	25	75	100	4
MB-C203	Bioinstrumentation	25	75	100	4
MB-C204	Immunology	25	75	100	4
MB-205	Practical		100	100	4
MB-206	**Industrial training/Survey/Research Project**		200	**200**	**8**
	Minor	25	75	**100**	**4**
	Total			**800**	**32**

III semester

Core Courses	Course Title	Marks		Total	Credit
		CIE	End Semester Examination		
MB-C301	Microbial Metabolism	25	75	100	4
MB-C302	Biostatics and Computer Application	25	75	100	4
MB-C303	r DNA technology	25	75	100	4
MB-E304	Computational biology	25	75	100	4
MB-E305	Microbial Genomics and Proteomics				
MB-306	Practical		100	100	4
	Industrial training/Survey/Research Project				
	Total			**500**	**20**

IV semester

Core Courses	Course Title	Marks		Total	Credit
		CIE	End Semester Examination		
MB-C 401	Medical Microbiology	25	75	100	4
MB-C402	Industrial Microbiology	25	75	100	4
MB -E403	Food and dairy Microbiology	25	75	100	4
MBE-404	Environmental Microbiology				
MB 405	Agricultural Microbiology	25	75	100	4
MB-E406	Plant Pathology				
MB- 405	**Practical**		100	**100**	**4**
MB-406	**Industrial training/Survey/Research Project**		200	**200**	**8**
	Total			**700**	**28**

Note:

1. Total number of credits in M.Sc. (Microbiology) I year/ B.Sc. research is 52 credits.
2. Total number of credits in M.Sc. (Microbiology) II year 48 credits.
3. Total credis required for M.Sc. (Microbiology will be 52=48 = 100
4. SKILL, ENTEPEUNERSHIP, EMPLOYABILTY

Programme Outcomes (PO)

On completing Masters in Microbiology, the students shall be able to realize the following outcomes:

PO1: Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in day-to-day life.

PO2: Acquire the skills in planning and performing and handling scientific instruments during laboratory experiments

PO3: Able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solutions to the problems.

PO4: Learn how an interdisciplinary approach helps in providing better solutions and new ideas for sustainable development.

PO5: Understand the knowledge of subjects in other faculties that can greatly and effectively influence the evolving new scientific theories and inventions.

PO6: Imbibe ethical, moral and social values in personal and social life

PO7: Develop various communication skills which we will help in expressing ideas and views clearly and effectively.

PO 8: Ability to think logically and creatively, and to solve scientific problems

PO 9: Equipped to take up a suitable position in academia or industry or Institutions and to pursue a career in research.

Programme Specific Outcomes (PSO)

On completing M.Sc. Microbiology Programme, the students shall be able to realise following outcomes:

PSO 1: Shall be able to design and execute experiments related to Basic Microbiology, Molecular Biology, Immunology, Recombinant DNA Technology, Biochemistry, Environment, Agriculture, Medical, Industrial, Food Microbiology.

PSO 2: Shall be able to perform minor research projects incorporating techniques of Basic and Advanced Microbiology. The learners will be equipped to take up a suitable position in academia or industry or Institutions and to pursue a career in research if so desired.

PSO 3: Shall be able to compete in national level competitive exams such as NET-JRF or GATE or International exams and can pursue career in higher studies

PSO 4: Shall practice safe microbiology, using appropriate protective, biosafety and emergency procedures.

PSO 5: Shall have in-depth theoretical and practical knowledge of huge diversity of microorganisms, their metabolism & physiology, concepts of molecular genetics and genetic engineering, biosynthetic pathways, enzymology, microbial pathogenicity, role of microbes in food, agriculture and environment, health and disease.

PSO 6: Shall be able to apply the scientific method and hypothesis testing in the design and execution of experiments including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.

PSO 7: Shall be able to communicate scientific results to the general public and experts by writing well-structured reports and contributions for scientific publications and posters, and by oral presentations.

M.SC. MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C101 MYCOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview Status of fungi in living world, Fungal Diversity of major taxonomic groups, Life cycle and sexual process in fungi and fungal metabolites.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: Student will have basic knowledge of status, classification, phylogeny of fungi and their role in biotechnology

CO2: Student will have specific knowledge of fungi belonging to various taxonomic groups: Gymnomycota, Mastigomycotina, Amastigomycotina

CO3: Student will have specific knowledge of fungi belonging to various taxonomic groups: Ascomycotina, Basidiomycotina, Deuteromycotina

CO4: Students will be acquainted with Life cycle and sexual process in fungi, Genetic variation in fungi and fungal metabolites

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	-	1	1	-	-	-	3	1	1	1	-	2	-	1
CO2	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO3	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	-	-	1	1	-	-	1	1	1	1	1	-	3	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C101 MYCOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Status of fungi in living world, general features of fungi and fungus like organisms, recent trends in the classification of fungi, physiology and growth of fungi, nutritional and environmental factors affecting growth, saprotrophs, parasites of Mutualistic symbionts, physiology of reproduction in fungi, Phylogeny of fungi. **Fungi and Biotechnology** Production of alcoholoic beverages, antibiotics, organic acids, ergot alkaloids, the cultivation of fungi for food- Mushrooms, mycofoods, Role of fungi in agriculture and forestry- Mycorrhizae and their application,	**15**
UNIT-II **Fungal Diversity- major taxonomic groups, structure, reproduction, life cycle and significance of the following representative:** 1. Gymnomycota- Cellular slime moulds (Dictyostelium), Plasmodial slime moulds (myxomycetes) 2. Mastigomycotina- *Coelomomyces*, *Lagenidium*, *Achlya*, *Phytophthora*, *Peronospora*, *Plasmodiophora* **3.** Amastigomycotina- Zygomycotina, *Mucor*, *Syncephalastrum*, *Blakeslea*, *Cunninghamella*, *Entomorphthora*.	**15**
UNIT- III **Fungal diversity contd.** 1. Ascomycotina- *Taphrina*, *Chaetomium*, *Morchella*, *Neurospora* 2. Basidiomycotina- *Puccinia*, *Melampsora*, *Polyporus*, *Lycoperdon* **3.** Deuteromycotina- *Fusarium*, *Cercospora*, *Curvularia*, *Beauveria*, *Microsporum*	**15**
UNIT- IV 1. Life cycle and sexual process in fungi, 2. Genetic variation in fungi- Nonsexual variations- haploidy, heterokaryosis, parasexuality, sexual variations, homothallisum and heterothallium, Mutation, physiological specialization. 3. Mycopesticides **4.** Mycotoxins.	**15**

Suggested Books:

1. Introductory Mycology, CJ Alexopoulos, CW Mims, M Blackwel, JohnWiley& Sons.
2. The Fungi: An Advanced Treatise, GC Ainsworth, KF Sparrow, AS Sussman.
3. An Introduction to Fungi, HC Dube, VikasPubl, New Delhi.
4. The Fungi, PD Sharma, Rastogi Publications, Meerut
5. Fungi: Experimental Methods in Biology, R Maheshwari, CRC Press, Boka Raton, Florida
6. Introduction to Fungi, J Webster & WS Roland, Cambridge University Press.
7. A Text Book of Modern Plant Pathology, KS Bilgrami, HC Dube.
8. Plant Pathology, RS Mehrotra.
9. Fungi and Plant Disease, VK Gupta, TS Paul
10. Diseases of Crop Plants in India, Rangaswamy&Mahadevan.
11. Plant Pathology, GN Agrio Elsevier Academic Press.
12. Molecular Plant Pathology, Dickinson CM, Bios Scientific Publisher
13. Plant Pathology: Concepts and Laboratory Exercises, NT Robert, MT Windham, ASWindham, CRC Press.
14. Principles of Plant Pathology, RS Sing, Oxford and IBH Publishing Co. Pvt Ltd.

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C102VIROLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objectives of this course are to provide basic understanding of the nature of human and plant viruses (including phages), viral classification, cultivation of viruses and viral diseases.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to

CO1: Explain the key concepts in virology having knowledge of Classification, Morphology and Chemistry of Viruses

CO2: The students will know about various Virus replication Strategies

CO3: Students will be able to define and explain Subviral pathogens, Pathogenesis of viral infection and Anti-viral strategies-prevention and control of viral diseases

CO4: Students will be acquainted with History and development of plant virology, cryptograms, and classification of plant viruses and viroids and have knowledge of Symptoms of plant virus diseases, transmission of plant viruses, viral and viroid diseases and their

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	-	2	-	-	1	2	2	2	2	1	2	-	2
CO2	3	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1
CO3	3	-	-	-	2	-	-	-	1	-	1	3	-	-	-	1
CO4	2	-	-	-	2	-	-	-	1	-	1	3	-	-	-	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C102VIROLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I: **Classification, Morphology and Chemistry of Viruses:** Virus evolution and classification, properties of viruses, virus structure, Techniques for visualization and enumeration of viral particles, measuring biological activity of viruses, assays for virus estimation and manipulation, characterization of viral products expressed in infected cells.	**15**
Unit II **Virus replication Strategies:** Principal events involved in replication: Adsorption, penetration, uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and release, viral-host interaction, Host response to viral infection. Identification of virus prototypes associated with different virus replication schemes; Details on important viruses namely Herpesvirus, Poliovirus, Influenza virus, Adeno Virus, Poxviruses, Hepatitis Viruses, coronaviruses, Retroviruses.	**15**
Unit III **Subviral pathogens:** HDV, Prions, Viroids **Pathogenesis of viral infection:** Stages of infection, Patterns of some viral diseases-epidemiology, transmission, infection, symptoms, risk, transformation and oncogenesis, emerging viruses. **Anti-viral strategies-prevention and control of viral diseases:** Host specific and nonspecific defense mechanisms involved in resistance to and recovery from virus infections. Role of interferon in viral infections. Contributions of various host defense mechanisms in viral infections; History of vaccines especially smallpox and polio. New methods: subunit vaccines,anti-idiotype and DNA vaccines.	**15**
Unit IV **History and development of plant virology, cryptograms, and classification of plant viruses and viroids:** Brief history of virology highlighting the significant contributions of scientists to the development of plant virology; significance of plant virology and modern classification of plant viruses and viroids according to ICTV; and cryptograms of various plant viruses and virus groups **Symptoms of plant virus diseases, transmission of plant viruses, viral and viroid diseases and their control:** General discussion on symptoms caused by viruses and viroids in diseased economically important trees and agricultural crops, and their control including development of virus disease resistant transgenetics	**15**

Suggested Books:

1. Medical Virology 10 Th Edition by Morag C and Tim bury M C .ChurchilLivingstone, London.
2. Introduction to Modern Virology 4th Edition by Dimmock N J, Primrose S. B.. Blackwell Scientific Publications. Oxford.
3. Virology by Conrat H.F., Kimball P.C. and Levy J.A.Prentice Hall, Englewood Cliff, New Jersey.
4. Text Book on Principles of Bacteriology, Virology and Immunology Topley and Wilsons.
5. Molecular Biology, Pathogenesis and Control by S.J. Flint and others. ASM Press, Washington, D.C.
6. Applied Virology. 1984. Edited by EdonardKurstak. Academic Press Inc.
7. Introduction to Modern Virology by Dimmock.

M.SC. MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C103 BACTERIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The course objectives are to provide knowledge on: landmark discoveries and contribution of several Microbiologists in the field of Microbiology, different domains classification, familiarity with the bacterial taxonomy and their conventional and molecular characterization using modern methods, knowledge of their cultivation and growth requirement, life cycles of important groups of bacteria.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to:

CO1: Explain the key concepts in Microbiology and Bacteriology. Students will get the basics and understand the importance of Microbiology. Students will be acquainted with the concept of bacterial taxonomy. They will understand how Microbiology developed and what is the scope of the various branches of the subject.

CO2 Students will be able to define and state the principles of various techniques used in microbiology. The course will enable them to understand staining techniques, CFU count and characterization of microbes etc. The students will know various culture media and their applications and also understand various physical and chemical means of sterilization

CO3: Students will be able to describe morphological & physiological characters, genetic interrelationship, taxonomic sub-division of bacteria having importance in human health and economy

CO4: At the end of the course, Bacteriology will provide the better understanding of Morphological & physiological characters, taxonomic sub-division & their importance of Pathogenic Bacteria

	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	-	-	3	-	-	-	1	1	2	1	1	1	-	2
CO2	1	-	-	1	1	-	-	-	1	-	-	1	-	3	-	1
CO3	1	-	-	1	1	-	-	-	1	-	-	1	-	3	-	1
CO4	1	-	-	1	1	-	-	-	1	-	-	1	-	3	-	1

M.SC. MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C103 BACTERIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I History, scope and development of bacteriology, Sterilization, isolation, enrichment, pure culture and staining techniques, systematic study of bacteria; morphological, physiological, biochemical and serological studies, genetic characterization. Habitat, structure, reproduction & classification of bacteria.	**15**
UNIT- II 1. The photosynthetic bacteria; cyanobacteria, green bacteria, halobacteria and their economic importance 2. Methanogenic bacteria and their significance **3.** Chemoautotrophs and Methylotrophs: Nitrifying bacteria, sulphur oxidizers, iron bacteria and their economic importance.	**15**
UNIT- III 1. Enterobacteriaceae and related organisms, their morphological & physiological characters, genetic interrelationship, taxonomic sub-division & their importance in human health. **2.** Myxobacteria, cytophage group, filamentous & gliding chemoheterotrophs& filamentous sulphur oxidizing bacteria.	**15**
UNIT IV **Morphological & physiological characters, taxonomic sub-division & their importance of Pathogenic Bacteria-** Staphylococcus, Sterptococcus, Pnumococcus, Corynebacterium, Bacillus, Clostridium, Non-sporing anaerobes; organisms belonging to Enterobacteriaceae, Vibrios, NonfermentingBrucella, Mycobacteria, Spirochates, Actinomycetes, Rickettsiae, Chlamydie.	**15**

Suggested Books:

1. General Microbiology: R Y Stanier, Adelberg E A and J L Ingraham, Mac Millan Press Inc
2. Introduction to microbiology: Ingraham J L and Ingraham C A Thomson Brooks/ Cole
3. Principles of microbiology R M Atlas Wm C brown Publishers
4. Brock's biology of Microorganisms Madigan M T and Martinko J M Pearson Education Inc
5. Microbiology: An introduction: Tortora G J, Funke B R and Case C L Pearson Education Inc

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C104 MICROBIAL BIOCHEMISTRY AND BASIC ENZYMOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: This course deals with characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the energetics and regulation of different metabolic processes in microorganisms.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: Understanding the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions. Conceptual knowledge of aerobic and anaerobic respiration and various intermediary mechanisms involved, oxidative phosphorylation

CO2: Have knowledge of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, classification, structure, function of the above mentioned biomolecules

CO3: Can explain structure of biological membrane and can describe kinetics of transport across membrane and their types

CO4: Conceptual knowledge of properties, structure, functions of enzymes, enzyme kinetics and their regulation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	2	3	1	-	2	2	2	2	3	-	2	-	2
CO2	1	-	1	1	3	-	-	1	1	1	1	3	-	-	1	1
CO3	1	-	1	1	3	-	-	1	1	1	1	3	-	-	1	1
CO4	3	2	2	2	3	-	-	2	2	2	2	3	-	1	2	2

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C104 MICROBIAL BIOCHEMISTRY AND BASIC ENZYMOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Biomolecules – Chemical composition and bonding, three dimensional structure, configuration and confirmation. 2. Chemical reactivity – five general types of chemical transformation of : oxidation reduction reactions, nucleophilic substitution, electron transfer with in molecules producting internal rearrangement, group transfer reaction, condensation reaction 3. Water – weak interactions in aqueous system, ionization of water, weak acid and weak base, concept of pH &pKa, Buffers (bicarbonate buffering system). 4. Principles of Bioenergentics – Entropy, enthalpy and free energy. **5.** Oxidative and Photophosphorylation, ATP production	**15**
Unit II 1. Carbohydrates: Classification, Structure, chemical feature and function. 2. Lipids – Classification, Structure, chemical feature and function 3. Amino acids, peptides and proteins - Classification, Reaction & physical properties. Three dimensional structures of protein and protein folding. **4.** Nucleotides and nucleic acids	**15**
Unit III 1. Structural features of Biomembranes, 2. **Solute transport across membranes**: Introduction, Kinetics 3. Simple diffusion, facilitated transport: Symport, antiport and uniport. **4.** Avtive Transport**:** Primary and Secondary active transport: ABC transporters, Phosphotransferase system, Drug export systems.	**15**
Unit IV 1. Enzymes – Classification and factors affecting enzyme activity 2. Allosteric Enzymes and their regulation 3. Enzyme kinetics – Equilibrium and steady state theory (MichalisMenten equation) and determination of kinetic parameters. **4.** Enzyme inhibition – reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition	**15**

Suggested Books:

1. Biochemistry, Voet Donald and Voet J.G ., John Wiley and sons INC
2. Biochemistry, Zubay .G. - Wm.C.brown Publishers
3. The Physiology and Biochemistry of prokaryotes White .D. -Oxford Univ.press
4. Principles of Biochemistry, LehningerA.L.Cox and Nelson , CBS Publishers and Distribution Pvt.Ltd
5. Biochemistry, Stryer .L., W.H.Freeman and Co
6. Principle and Techniques –Practical Biochemistry Wilson. K. and Walker.J. -Cambridge University press
7. Biochemistry, Murray, Harpers McGraw Hill
8. Biochemistry, Satyanarayana and Chakrapani, Books and Allied Publishers
9. Fundamentals of Biochemistry, VoetDonald,J.W.Voet and Ch.W.Pratt, Jhon Willey & Sons Inc.
10. Enzyme Kinetics by Paul Engel. John Wiley and Sons. Inc., New York.

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-105 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Course Learning Outcomes:

Following successful completion of the course, the student will:

CO1. To impart practical skills on sterilization and pure culture techniques

CO2. Understand the working and understand how to operate major microbiology lab instruments

CO3. To understand the methods of identification, cultivation and preservation of various Microorganisms

CO4. To develop practical knowledge on biochemical characterization of microbes

CO5. To develop anaerobic cultivation methods and isolation of bacteria

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	3	-	1	1	1	1	-	2	1	1	1	-	2	1	1
CO2	-	3	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO3	-	3	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO4	1	3	-	1	1	1	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-105 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Laboratory basic rules and regulations in the microbiology lab and the procedure of cleaning and preparation of materials for lab experiment

Experiment No. 2
Enumeration (counting) of bacteria by plate count or serial dilution -agar plate technique

Experiment No. 3
To Determine the counting of the bacterial population by the use of a spectrophotometer

Experiment No. 4
To perform the principle and methods of different staining techniques in Bacteria (Simple staining, Negative staining, Gram's staining, Acid fast staining

Experiment No. 5
To perform the Lactophenol cotton blue mounting of fungi

Experiment No. 6
To study the control of Microorganisms by physical agents: Moist Heat

Experiment No. 7
To study the control of Microorganisms by physical agents: Dry Heat

Experiment No. 8
To study the types of Physical methods: Ultraviolet radiation

Experiment No. 9
Evaluation of antiseptics by filter paper disc methods

Experiment No. 10
Preparation of basic liquid media (broth) for the routine cultivation of bacteria

Experiment No. 11
Preparation of basic solid media, agar slants and agar deep tubes for the routine cultivation of microorganisms

Experiment No. 12
To isolate the fungi from soil their identification on the basis of cultural, morphological and biochemical characteristics.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB-C201MOLECULAR BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objective: The objective of the course is to understand the principles and techniques of molecular biology. The students will learn the concept of gene, modulation of gene its regulation, modes of transmission including advanced knowledge in a specialized field of molecular biology

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: Advanced understanding of fundamental concepts of molecular biology and genetics. Improved understanding of molecular basis of genome organization and function. Develop deep understanding of mechanism of DNA replication.

CO2: Understand mechanism of transcription in prokaryotes and eukaryotes. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes. Develop understanding of the molecular basis of gene silencing and RNA processing.

CO3: Knowledge of mechanism of translation and Co- & post- translation modification in prokaryotic and eukaryotic system. To get an insight in to the wide range of mechanisms required for gene regulation in different organisms.

CO4: Ability to understand the protein localization in various organelles and learn the molecular mechanism of antisense and ribozyme technology.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	2	3	3	-	-	1	3	2	2	3	-	3	2	2
CO2	3	-	2	2	3	-	-	1	2	3	2	3	-	3	2	3
CO3	3	-	2	2	3	-	-	1	2	3	2	3	-	3	2	3
CO4	3	3	2	3	3	1	-	2	2	3	3	3	3	2	2	3

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB-C201MOLECULAR BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Introduction of molecular biology and genetics. 2. Genome organization – genome, c-value, c-value paradox, genome complexity, 3. DNA Replication Prokaryotic and eukaryotic DNA replication, mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication.	**15**
Unit II 1. Transcription Prokaryotic transcription and eukaryotic transcription, RNA polymerase, General and specific transcription factors, regulatory element and mechanisms of transcription regulation. 2. Transcriptional and post transcriptional gene silencing. 3. Modification of RNA 5'-cap formation, transcription termination, 3' end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA, mRNA stability.	**15**
Unit III 1. Translation Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation. **2.** Co- and Post- translational modifications of proteins.	**15**
Unit IV 1. Protein localization and transport Synthesis of secretary and membrane, import into nucleus. Mitochondria E. R., Golgi complex, chloroplast, and peroxisomes, Receptor mediated endocytosis. 2. Antisense and ribozyme technology Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation. Disruption of RNA structureand capping biochemistry of ribozyme; hammerhead, hairpin and other ribozymes, strategies for designing ribozyme, application of antisense and ribozyme technologies.	**15**

Suggested Books:

1. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.
2. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.
3. Watson et al., Molecular Biology of the gene, 5th Edition, Pearson Prentice Hall. USA, 2003.
4. B. M. Turner, Chromatin & Gene regulation, 1st Edition, Wiley-Blackwell, 2002.
5. Benjamin Lewin, Gene X, Edition, Jones and Barlett Publishers, 2007.
6. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
7. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.
8. Recombinant DNA technology by Watson et. al., (Scientific American Books).
9. Principles of Gene Manipulation by Old and Primrose.(Blackwell).
10. Molecular Biotechnology by Glick.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C202MICROBIAL GENETICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview of DNA Damage and DNA repair. The learner will also the gene mapping of E.coli, Molecular markers for genome analysis. as well as new generation recombinant DNA vaccines

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: The students will remember about basic concept of mutation and recombination, types of DNA damage and repair systems

CO2: The students will understand the methods of genetic analysis types of Recombination, QTL mapping and molecular markers in genome analysis

CO3: Students can apply the Principle of mapping genes and can identify group of genes for a phenotype

CO4: Student apply molecular tools for production of recombinant proteins

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	-	2	-	-	2	1	3	2	3	-	2	2	2
CO2	3	2	2	-	2	2	-	2	1	3	2	3	-	2	3	3
CO3	3	2	2	-	2	-	-	2	1	3	2	3	-	2	1	1
CO4	3	2	2	-	2	-	-	2	3	3	2	3	-	2	2	2

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C202MICROBIAL GENETICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I 1. Gene as unit of mutation and recombination. 2. Molecular nature of mutations; mutagens. 3. Type of DNA damage (deamination, oxidative damage, alkylation, pyridine dimmers). 4. Ame's test for mutagenesis **5.** DNA repair- photorepair, excision or dark repair, recombinational repair, SOS repair.	**15**
UNIT-II 1. Methods of genetic analysis and genetic mapping, Pedigree analysis, lod score for linkage testing. 2. Recombination - Homologus recombination - Holiday junction, site specific recombination - FLP/FRT and Cre lox recombination, Rec A and other recombinases 3. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. **4.** Molecular markers in genome analysis, RFLP, RAPD, AFLP, STS, SCAR (Sequence characterized amplified regions), microsatellite, SSCP, QTL.	**15**
UNIT- III 1. Bacterial genetic system: transformation, conjugation and transduction. Bacterial genetics map with reference to *E.coli*. **2.** Complementation analysis, cir-trans test, deletion mapping, Benzer's concept of cistron, concept of overlapping genes.	**15**
UNIT- IV 1. Southern, Northern and florescence in situ hybridization for genome analysis 2. Chromosome micro-dissection and micro-cloning. **3.** Important application of advances in microbial genetics. Production of proteins. **4.** Conventional as well as new generation recombinant DNA vaccines, design and advantages	**15**

Suggested Books:

1. Molecular Genetics of Bacteria by J. W. Dale. John Wiley and Sons.
2. Modern Microbial Genetics. Streips and Yasbin. Niley Ltd.
3. Moleculat Biology of the Gene , J.D. Watson, N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. The Benjamin / Cummings Publications Co. Inc. California.
4. Gene XI by Lewin Oxford University Press..
5. Microbial Genetics by Frefielder. 4th Edition.
6. Molecular Genetics of Bacteria, Larry, Snyder and Wendy, Champness, ASM Publications.
7. Methods of General and Molecular Bacteriology, 1993. Edited by Philip. Gerhardt, ASMPublications.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C203 BIOINSTRUMENTATION
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: To introduce the learner to the basic concept of qualitative and quantitative analysis of various biological samples. Students would be taught about the biophysical and biochemical techniques currently available to investigate the structure and function of the biological macromolecules. Learner would be made aware about the various separation techniques and its instrumentation, principles behind each technique, make them familiar with various methods of analysing the output data and to build a strong foundation in the area of microbiology.

Course Learning Outcomes: Upon successful completion of the course, the student will able to:

CO1: To understand and interpret the basic principles, Instrumentation and applications of UV-Visible spectrophotometry, Infrared (IR) spectroscopy, Fluorescence spectroscopy, Mass spectroscopy.

CO2: The students will gain knowledge oF principle, instrumentation and applications Raman spectroscopy, Electron spin resonance (ESR) spectroscopy, Nuclear magnetic resonance (NMR) Spectroscopy, Circular- Dichroism (CD) spectroscopy, X-ray Crystallography.

CO3: Understand and Interpret Basic Principle, Types and Applications of Centrifugation, Chromatography, Electrophoresis, Autoradiography

CO4: Can explain basic principle and components of Microscopy, the process sequencing techniques for proteins and nucleic acids , correctly interpret the Detection of molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH & GISH

	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	3	1	-	3	2	3	2	3	3	-	1	2
CO2	3	3	2	2	3	1	-	3	2	3	2	3	3	-	1	2
CO3	3	2	2	1	2	1	-	2	1	2	1	3	3	-	1	2
CO4	3	3	2	1	3	1	-	3	1	3	1	3	3	-	2	2

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C203 BIOINSTRUMENTATION
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I – 1. Photometry – Basic principles, Instrumentation and applications of UV-Visible spectrophotometry 2. Infrared (IR) spectroscopy and its applications 3. Fluorescence spectroscopy – principle, instrumentation and applications. **4.** Mass spectroscopy – Mass analyzers, principle, instrumentation and applications.	**15**
Unit II - 1. Raman spectroscopy and its applications 2. Electron spin resonance (ESR) spectroscopy and applications 3. Nuclear magnetic resonance (NMR) Spectroscopy – principle, instrumentation and applications 4. Circular Dichroism (CD) spectroscopy – principle, instrumentation and applications 5. X-ray Crystallography – principle, instrumentation and applications	**15**
UNIT III – 1. Centrifugation – basic principle, types and applications 2. Chromatography: Principle, types and applications of Paper, Thin layer, High performance liquid chromatography; Column Chromatography – Gel filtration, Ion exchange chromatography, affinity chromatography, adsorption chromatography. 3. Electrophoresis: Principle, types and applications; Agarose gel, PAGE, SDS-PAGE, Iso-electric focusing, Two Dimensional gel electrophoresis, Immuno-electrophoresis, Capillary electrophoresis, Pulse Field gel electrophoresis. **4.** Autoradiography – Principle and applications, radioisotopes used in biology and their application.	**15**
Unit IV – 1. Microscopy – Basic principle and components of microscope, phase contrast and fluorescent and Confocal microscopes 2. Electron microscopy – principle and applications 3. Sequencing techniques for proteins and nucleic acids **4.** Detection of molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH and GISH	**15**

Suggested Books:

1. Instrumental Methods of Analysis. H.H. Willard, L.L. Merritt Jr. and others. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall
5. Ltd.
6. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons.
7. Inc., New York.
8. Analytical Biochemistry by Holme.
9. Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C204 IMMUNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview of immune system to the learners. The learner will understand structure, organization and functions of various components of the immune system like antigen, antibody, organs, MHC, cytokines and others in the defence system of the body. It would also make them understand the concepts of innate and adaptive immunity, immune diversity and specificity, autoimmunity, hypersensitivity, transplantation and others.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Describe the fundamental bases of immune system and immune response, Explain about the importance of innate immunity and acquired immunity, Describe the structure and organization of various components of the immune system

CO2: Analyse the genetic basis for the expression of immune cell receptors and generation of immunological diversity, Antigens antibody interactions, Major histocompatibility complex and Regulation of immune response

CO3: Understand the operation and the mechanisms of Complement system, Cell mediated cytotoxicity, Hypersensitivity, Catalytic antibodies and comprehend the techniques and the underlying principles used in Hybridoma Technology and monoclonal antibodies

CO4: The students will gain knowledge about Host parasite interaction, general principles of cell communication, cell adhesion and different roles in causing oncogenesis

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C204 IMMUNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Immune response: innate and adaptive immune system, cells and molecules of immune system, Cells of the Immune system : Hematopoiesis and differentiation , Lymphocyte trafficking , B-lymphocyte , Macrophage Dendritic cells , Natural killer and Lymphokine activated killer cells, Eosinophils , Neutrophils and Mast cells . 2. Clonal selection theory. 3. Organization and structure of lymphoid organ. 4. Nature and biology of antigens and super antigens. **5.** Antibodies structure and function.	**15**
Unit II- 1. Antigens antibody interactions. 2. Major histocompatibility complex. 3. BCR & TCR, generation of diversity. 4. Regulation of immune response: - antigen processing and presentation , generation of humoral and cell mediated immune response . - Activation of B & T –lymphocytes. - Cytokines and their role in immune regulation. - T-cell regulation, MHC restriction. - Immunological tolerance.	**15**
Unit III – 1. Complement system. 2. Cell mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity. 3. Hypersensitivity. **4.** Catalytic antibodies **5.** Hybridoma Technology and monoclonal antibodies.	**15**
Unit IV – 1. Host parasite interaction 2. Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, 3. Cellular communication Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. **4.** Cancer immunology	**15**

Suggested Readings:

1. Kuby Immunology, Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne , Janis Kuby,
2. Immunology and Immunopathology by Stewart.
3. Cellular and Molecular Immunology by Abul K. Abbas et al.
4. Textbook of Immunology by Barret.
5. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company (5th Edition), Mosby (6th Edition)
6. Immunology by J.Kuby, Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Freeman & Company Mosby publishers.

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-205 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

CO1. To develop practical knowledge on the estimation of macromolecules

CO2. To demonstrate the estimation of biomolecules quantitatively

CO3. To impart practical knowledge on the production, separation and partial purification of enzymes

CO4. Understand the procedure of separating compounds by using chromatography

CO5. To impart hands-on training in DNA and RNA isolation methods.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	-	-	1	1	-	1	-	2	1	1	1	-	2	1	1
CO2	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO3	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO4	1	-	-	1	1	-	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-205 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Isolation of DNA from plant materials
Experiment No. 2
To perform electrophoresis of a DNA sample
Experiment No. 3
Determination of Purity of Nucleic Acid (DNA) By UV Absorption Method
Experiment No. 4
To study the concept of Southern Blotting: Principle, Procedure, and Applications
Experiment No. 5
To study autosomal/sex-linked disorder by pedigree analysis in humans
Experiment No. 6
Restriction Enzymes in Genome Mapping and Analysis
Experiment No. 7
To study the separation, purification, identification and application of compounds by Chromatography
Experiment No. 8
To Detect the Ag-Abs interaction by double immune diffusion method
Experiment No. 9
To study the Serological diagnosis by Tube agglutination test (Widal test)
Experiment No. 10
Determination of Blood group by Slide agglutination test

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C301 MICROBIAL METABOLISM
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview of growth kinetics of microorganism to the learners. The learner will understand metabolic diversity among Microorganisms. It would also make them understand the concepts of catabolism and anabolism

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Explain the mathematical expression of growth, can measure growth yields, generation time. Students can also describe the effect of nutrient concentration and environmental factors on growth rate.

CO2: The students will gain knowledge about Microbial nutrition, metabolic diversity among Microorganisms.

CO3: Students will be able to describe catabolism of Carbohydrates, Lipid, and Amino acid.

CO4: Describe Anabolism of Carbohydrates, Lipids, Amino Acids, Nucleic Acids, Polyamines

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	-	-	1	1	2	1	2	-	-	-	1
CO2	2	1	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	-	1	1	3	1	2	-	1	-	2
CO4	2	-	1	1	3	-	-	1	1	3	1	3	-	1	-	1

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C301 MICROBIAL METABOLISM
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Growth and cell division: mathematical nature and expression of growth. 2. Measurement of growth, growth yields, steady state growth and continuous growth. 3. Effect of nutrient concentration in growth rate. **4.** Effect of environment on microbial growth	**15**
Unit II **1.** Overview of Microbial nutrition. **2.** Metabolic diversity among Microorganisms • Photosynthesis in microorganisms; Role of chlorophylls, Carotenoids and phycobilins. • Chemolithotrophy: Hydrogen-ion-nitrate-oxidizing bacteria; nitrate and sulfate reduction. • Methanogenesis and acetogenesis:fermentation's-diversity. • role of anoxic decompositions: nitrogen metabolism, nitrogen fixation; hydrocarbon transformation.	**15**
Unit III 1. Carbohydrate Catabolism: Glycolysis, Citiric acid cycle, Pentose phosphate pathway, EmbedenMayerhoff pathway. 2. Lipid Catabolism –Oxidation of fatty acids. **3.** Amino acid oxidation and production of Urea.	**15**
Unit IV 1. Carbohydrate Anabolism – Gluconeogensis, glyoxalate pathway and regulation. 2. Lipid Biosynthesis 3. Biosynthesis of Amino acids – tryptophan, alanine, cysteine, histidine, glutamate **4.** Biosynthesis of nucleotides and poly amines	**15**

Suggested Books:

1. Microbial Physiology and Metabolism, Caldwell D.R., Brown Publishers.
2. Microbial Physiology, Moat A.G. and Foster J. W. 1999.. Wiley.
3. Advances in Microbial Physiology. A.H. Rose. Academic Press, New York
4. Biochemistry by Geoffrey L. Zubay. 4th Edition. Brown Co, USA. 1999.
5. Microbial Physiology by A.G. Moat, J. W. Foster, M. P. Spector. 3rd Edition. John Wiley & Sons. 2002
6. Lehninger Principles of Biochemistry by D. L. Nelson, M. M. Cox. 6th Edition. W. H. Freeman. 2012
7. The Physiology and Biochemistry of Prokaryotes by D. White, J. Drummond, C. Fuqua. 4 th Edition. Oxford University Press. 2011.
8. Microbial Biochemistry by G. N. Cohen. 2nd Edition. Springer. 2014.
9. Lippincott's Illustrated Reviews: Biochemistry edited by D. R. Ferrier. 6th Edition. Lippincott Williams & Wilkins. 2013
10. Biochemical Calculations: by Irwin H. Segel. 2nd Edition. Wiley. 2004. 8. Understanding Enzymes by T. Palmer, E.Horwood. 3rd Edition. Wiley. 1991.

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB -C302BIOSTATISTICS, COMPUTER APPLICATION AND BIOINFORMATICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed knowledge of description, classification, tabulation of data, its graphical representation and can do the statistical analysis. Have basic knowledge computers and bioinformatics

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: To understand various statistical terminologies and their description, classification, tabulation of data, graphical representation and Measures of central tendency and dispersion.

CO2: Student can comparatively analyse experimental data by utilizing different statistical modules

CO3: Student can explain the basic working of a computer in the modern era and learnt the use of different software, internet and its application

CO4: The students will gain knowledge of scope of bioinformatics, to learn various computational techniques and online tools of bioinformatics

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	-	2	1	1	2	1	2	-	-	-	1
CO2	2	1	1	2	3	-	2	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	1	1	1	3	1	2	-	1	-	2
CO4	2	-	1	1	3	-	2	1	1	3	1	3	-	1	-	1

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB -C302BIOSTATISTICS, COMPUTER APPLICATION AND BIOINFORMATICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Brief description, classification, tabulation of data and its graphical representation 2. Measures of central tendency and dispersion mean; median; mode range. Standard division, variance. 3. Simple linear regression and correlation. **4.** Probability and Probability distribution.	**15**
Unit II 1. Test of significance; null hypothesis, alternative hypothesis, two types of errors, Level of significance, T test. 2. Analysis of variance in one way classification (one factor analysis). 3. Analysis of variance in two way classification (two factor analysis). **4.** Chi Square test	**15**
Unit III 1. Introduction of digital computers organization low level and high level language binary number system. 2. Flow chart and programing techniques. 3. Introduction to data structure and data base concepts, 4. Introduction to MS-office software, covering Word processing. spreadsheets and presentation 5. Introduction to internet and its application.	**15**
Unit IV 1. Bioinformatics – an overview, introduction and scope of bioinformatics. 2. Biological database – Primary sequence database (Protein and DNA), Secondary database, composite database 3. Searching pairwise database BLAST, FASTA, Multiple sequence alignment (ClustalW, Psi BLAST). **4.** Computer aided drug designing.	**15**

Suggested Books:

1. Statistics in biology, Bliss, C.I.K. McGraw Hill, NewYork.
2. Practical Statistics for experimental biologist Wardlaw, A.C.
3. How Computers work, Ron White. Tech. Media
5. How the Internet Work, Preston Gralla Tech. Media.
6. Statistical Methods in Biology, Bailey, N.T. J. English Univ. Press.
7. Biostatistics - 7th Edition by Daniel
8. Statistics for Biologist, Campbell R.C., Cambridge University Press, UK.
9. INTERNET – CDC publication, India.
10. Bioinformatics. 1998 by Baxevanis

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C303 GENETIC ENGINEERING
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The course objectives are to provide knowledge on fundamental and applied aspects of genetic and molecular biology. The content include Genetic Engineering, patenting, Gene cloning, Site directed Mutagenesis, Gene Therapy and to understand the tools and techniques used in DNA technology

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student can relate the Scope of Genetic Engineering, patenting and modification of enzymes

CO2: Student can understand the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation and transformation.

CO3: Student of this course have knowledge on Mutagenesis and Protein Engineering, gene regulation and Processing of Recombinant proteins

CO4: The students will gain knowledge about Transgenic and gene Knock out Technologies, chromosome engineering, Gene Therapy, gene editing, regulation and silencing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	1	2	3	-	2	1	1	2	1	3	-	-	2	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO3	3	-	1	1	3	-	2	1	1	3	1	3	-	1	2	2
CO4	3	-	1	1	3	-	2	1	1	3	1	3	-	1	2	2

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C303GENETIC ENGINEERING
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Scope of Genetic Engineering. 2. Isolation of enzymes, in-vitro synthesis of DNA and patenting of life forms. 3. Restriction enzymes and modification enzymes. 4. Nucleic acid Purification and Yield Analysis. **5.** Nucleic Acid Amplification, PCR and Its application	**15**
Unit II 1. Gene cloning Vectors Plasmids, bacteriophage, phagemides, cosmids, Artificial Chromosomes. 2. Restriction mapping of DNA fragments and Map construction. 3. cDNA Synthesis - mRNA enrichment, reverse transcription, DNA primers, linkers, Adapters and their chemical synthesis, Library construction and screening. 4. Alternative strategies of Gene Cloning. Cloning interacting genes- Two and three hybrid systems. **5.** Nucleic acid microarrays.	**15**
Unit III 1. Site directed Mutagenesis and Protein Engineering. 2. How to study the Gene Regulation? DNA transfection, Northern blot, Primer extension, SI mapping, Rnase protection assay. 3. Expression Strategies for heterologous genes Expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells. 4. Processing of Recombinant proteins. Purification and stabilization of proteins.	**15**
Unit IV 1. Phase Display. 2. T-DNA and Transposon Tagging 3. Transgenic and gene Knock out Technologies Targeted gene replacement, chromosome engineering. 4. Gene Therapy. Vector engineering, Strategies of delivery, gene replacement/ augmentation, gene correction, gene editing, regulation and silencing.	**15**

Suggested Books:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.
6. Genetic Engineering by SandhyaMitra
7. Gene Technology by SN Jogdand.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E304COMPUTATIONAL BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The course objectives are to provide knowledge on biological databases, methods and algorithms, molecular phylogenetics, genomics and gene annotation

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student will able to remember different types of databases in terms of biological information and different formats of molecular biological data

CO2: Student will be able to understand methods and algorithms of pairwise and multiple sequence alignments, different approaches of motif detections, concept of orthology, paralogy and homology

CO3: Student will be able to apply laws of molecular phylogenetics for evaluating and interpretation of evolutionary trees.

CO4: Student will be able to analyse Organization and structure of prokaryotic and eukaryotic genomes. Genome annotation and databases

	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO3	3	-	1	1	3	-	-	1	1	3	1	3	-	1	2	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	2	2

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E304COMPUTATIONAL BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I: Biological Databases: Introduction. Types of databases in terms of biological information content. Protein and gene information resources. Different formats of molecular biology data. Specialized resources for genomics, proteomics and metabolomics.	**15**
Unit II: Sequence Alignment: Methods and algorithms of pairwise and multiple sequence alignment. Global and local alignment. Alignment scoring matrices. Database similarity searching. Different approaches of motif detection. Concept and use of protein families. Concept of orthology, paralogy and homology in gene and protein sequences	**15**
Unit III: Molecular Phylogenetics: Methods and tools for phylogenetic analysis. Creation evaluation and interpretation of evolutionary trees. Advantages and disadvantages of phenetic and cladistic approaches.	**15**
Unit IV: Genomics and Gene Annotation: Organization and structure of prokaryotic and eukaryotic genomes. Genome annotation and databases. Automated in-silico methods of finding gene and relevant features. Genome Sequencing using first and seconding generation sequencing methods. Advantages of genome sequencing projects in modern biological research.	**15**

Suggested Books:

1. Introduction to Computational Biology: An Evolutionary Approach by Haubold, Wiele. 1st edition. Springer International. 2006.
2. Introduction to Bioinformatics by A. Lesk. 3rd edition. OUP India. 2009.
3. Statistical methods in Bioinformatics: An introduction by W. Ewens, G.R. Grant. 2nd Edition. Springer-Verlag. 2006.
4. Bioinformatics: Sequence and genome analysis by D. Mount. 2nd edition. Cold Spring Harbor Lab Press. 2004.
5. Bioinformatics: A practical guide to the analysis of genes & proteins. Edited by Baxevanis, Outlette. 2nd edition. John Wiley and Sons. 2001.
6. An Introduction to Protein Informatics by K-H Zimmermann. 1st edition, Springer International. 2007.
7. Fundamental Concepts of Bioinformatics by Krane. 1st edition. Pearson Education. 2003. 8. Discovering Genomics, Proteomics and Bioinformatics by Campbell. 2nd edition. Campbell Pearson Education. 2007.
8. Structural bioinformatics: an algorithmic approach by F. J. Burkowski. 1st edition, Chapman & Hall/CRC. 2009.
9. Structural Bioinformatics edited by J. Gu, P.E. Bourne. 2nd Edition. Wiley-Blackwell. 2009.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E305 MICROBIAL GENOMICS AND PROTEOMICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: To introduce the learner to the basic concept of functional and structural genomics, its Impact in agriculture, environment and medicine, use of genome sequencing for creating gene libraries, analysis of DNA and protein and able to use internet and networking for filing patents and copyrights.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student will able to understand concept of functional and structural genomics and their use in agriculture, environment and medicine

CO2: Student can apply various cloning approaches to create gene libraries

CO3: Student will be able to evaluate the structure of proteins using tools like swissprot and can analyse DNA using tools such as microarray and creating DNA chips

CO4: Student will be able to evaluate the database such as EMBL, NCBI and learned to file patents and copyrights.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO3	3	1	1	1	3	-	2	1	1	3	1	3	-	1	2	2
CO4	3	1	1	1	3	-	-	1	1	3	1	3	-	1	2	2

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E305MICROBIAL GENOMICS AND PROTEOMICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I The genomic era-functional and structural genomics, current status of microbial genomics projects. Impact in agriculture, environment and medicine.	**15**
Unit II The strategies: whole genome sequencing, shotgun and clone by clone approach. Sequencing methods, large insert cloning vector, gene libraries.	**15**
Unit III Sequence analysis, Swissprot and other protein analysis tools, BLAST and DNA analysis tools, microarray and design of chips.	**15**
Unit IV The databases like EMBL gene bank, NCBI etc., use of internet and networking, submission of data to gene banks patents and copyrights.	**15**

Suggested Books:

1. MicrobialGenomesRead, T D. Nelson, K E, FRASERraser, C M. . USA: Humana Press, Inc.,
2. Discovering Genomics, Proteomics and BioinformaticsHEYEReyer, L. Camlbell, A. USA Cold Spring Harbor Lab. Press, 2006. 352 p. ISBN 0-8053-4722-4
3. Concepts and Techniques in Genomics and Proteomics, N. Saraswathy and P. RamalingamWooodhead publishing
4. Genomics and Proteomics: Principles, Technologies, and Applications. D. Thangadurai, J. Sangeetha CRC Press

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-306 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

CO1. To gain an understanding of introductory and applied Bioinformatics

CO2. Determine the effect of environmental factors influencing the growth of microorganisms

CO 3: Perform basic laboratory experiments in Biochemistry, Genetics and Bioinformatics

CO4. To associate the principle and instrumentation of Laboratory Instruments and to apply bioanalytical

CO5. To impart knowledge for the use and operation of microscopes.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	2	-	1	1	1	1	-	2	1	1	1	-	2	1	1
CO2	-	2	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO3	-	2	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO4	1	2	-	1	1	1	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-306 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Determination of bacterial growth by turbidity measurements (spectrophotometer method)
Experiment No. 2
To Study Bioinformatics with a basic local alignment search tool (BLAST) and fast alignment (FASTA)
Experiment No. 3
Identification of appropriate hypothesis testing procedure based on the type of outcome variable and number of samples by Chi-Square Test
Experiment No. 4
To familiarize with the use of a wide variety of internet applications, and biological databases by applying these methods for the research purpose
Experiment No. 5
Sequence alignment & phylogenetic analysis by using different tools
Experiment No. 6
Introduction to bioinformatics databases: NCBI, EMBL, etc.
Experiment No. 7
To understand the theoretical and practical development of useful tools for automation of complex computer jobs, and making these tools accessible on the network from a Web browser.
Experiment No. 8
Analysis of Variance one-way and two-way

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C401MEDICAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objectives of this course are to provide basic understanding of pathogenic microorganisms, disease due immune failure, common viral infections, diagnosis of important disease/syndrome and General concepts in epidemiology and disease control-conventional and new generation vaccines

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student will able to remember medically important microorganisms, dermatophytes dimorphic fungi, opportunistic fungal pathogen.

CO2: Student will be able to understand immunological reactions due to transplantation, intercellular, parasites helminthes & viruses and immunological malfunction

CO3: The students will gain knowledge about Common human infection of virus, protozons, Metazoans

CO4: Student will be able learn about Strategies/approaches in the diagnosis of important disease/syndrome and also learn concepts in epidemiology and disease control

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C401MEDICAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Early discovery of pathogenic microorganism; development of bacteriology of scientific disciplines; Normal microbial flora of the human host; role of resident flora; Classification of medically important microorganisms, dermatophytes dimorphic fungi, opportunistic fungal pathogen.	**15**
UNIT-II 1. Transplantation immunology 2. Immunity of infectious agents (intercellular, parasites helminthes & viruses) 3. Tumor Immunology. 4. AIDS and other Immunodeficiency. **5.** Autoimmunity	**15**
UNIT-III Common viral infection of human Herpes, Arbovirus, HIV (Symptoms, transmission, control, culture and reproduction); important protozons (Malaria, Amoebiasis, Taxoplasmosis, trypanosomiases, Leshmaniasis, Anaplasmosis); Metazoans: trematodes, Nematodes (Schistomiasis, Filariasis, Hookworms, Round worms).	**15**
UNIT IV Strategies/approaches (conventional and modern) in the diagnosis of important disease/syndrome: meningitis, urinary tract infection, sexually, wound infection etc. General concepts in epidemiology and disease control-conventional and new generation vaccines	**15**

Suggested Books

1. Medical Microbiology by MIMS, Play Fair, Roitt& Mosby Publishers,
2. Medical Microbiology by Melnick.
3. Textbook of Microbiology by Ananthanarayan, C.K.J.Panikar, Oreint Longman Ltd.
4. Medical Microbiology by David Greenwood, Richard C.B.Slack, John.F.Peutherer.
5. Medical Microbiology – A Clinical perspective by J.B.Sharma, paras publishing.
6. Medical Microbiology by Patrick R.Murray, Ken.S.Rosenthal, George.S.Kobayashi, Michael A.Ptaller.
7. Pharmaceutical Microbiology edited by W.B. Hugo & A.D. Russell, 6th Edition, Black well science.
8. Microbiology in clinical practice by Shanson D.C., 2nd edition, London; Wright

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C402 INDUSTRIAL MICROBIOLOGY

Course Objectives: This course elaborates on various processes and instruments used in Industrial Microbiology. It deals with different type of industrially important microorganisms their growth and preservation methods and their application in different processes related to industrial and food microbiology.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Comprehend the theoretical and practical understanding of Designing and application, Principles of biofermentation

CO2: Know how to Isolate, Maintain, Preserve & improve industrial strains, understand the rationale in medium formulation & design for microbial fermentation, sterilization of instrument medium and air.

CO3: Know process of downstream processing for purifying the desired product from fermentation broth.

CO4: Student will learn basic aspects of industrial production

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO2	3	1	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO3	3	-	1	1	3	-	-	1	1	3	1	2	-	1	1	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	1	2

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C402INDUSTRIAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I **Biofermantation:** Designing and application; Principles of biofermentation, monitoring and control of parameters (pH, oxygen, agitation, temperature, foam etc.), batch & continuous. computer control of fermentation process.	**15**
UNIT-II Isolation, Maintenance, Preservation & improvement of industrial strains, The isolation, preservation and improvement of industrially important and useful microorganisms. Industrial fermentation- typical media, media formulation, water, energy and carbon sources, nitrogen sources, minerals, vitamin sources, nutrient recycle, buffers, precursors and metabolic regulators, oxygen requirement.	**15**
Unit III **Downstream Processing:** Filtration of fermentation broths, ultracentrifugation, recovery of biological products by distillation, superficial fluid extraction.	**15**
Unit IV **Production aspects:** Microbial strains, substrates, strain improvement, flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), amino acids (lysine, phenylalanine, tryptophan), antibiotics (cephalosporins, tetracyclines, polyenes), enzymes and immobilized enzymes, SCP, microbial polyesters, biosurfactants.	**15**

Suggested Books:

1. Solid State fermentation in Biotechnology by Pandey.
2. Industrial Microbiology by Waiter.
3. Fermentation Microbiology and Biotechnology by Mansi.
4. Industrial Microbiology by Patel.
5. Biotechnology: A text book of Industrial Microbiology by Greger
6. Principles of Fermentation technology by Whitaker.
7. Industrial Microbiology by Prescot& Dunn.
8. Microbial Technology by J.H. Peppler& D. Perlman.
9. Industrial Microbiology by L.E.Casida.
10. Industrial Microbiology by B.M. Miller &W.Litsky.
11. Economic Microbiology by Rose,
12. Advances in Applied Microbiology by Ed.Perlman, Series of volumes.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E403ENVIRONMENTAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The main objective of this course is to impart the basic and advance knowledge about the microbial communities inhabiting in diverse environments, their role in environment and ecosystem wellness and interaction with various type of pollutants. The learner will be acquainted with the concepts of aquatic microbiology, aero microbiology, use of microbial population in microbial waste recycling and bioremediation, rumen microbiology and other related topics.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Explain various concepts of Microbial Ecology and describe role of microorganism in recycling of elements

CO2: Student will be able to describe the diverse microbial habitats such as soil, water, air and animal

CO3: The students will gain knowledge about microbial diversity in extreme environments.

CO4: Describe the role of microbes in solid and liquid waste management, gaining knowledge of various methods employed in sewage treatment and solid waste treatment.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	-	-	1	1	-	-	-	2	1	1	1	-	2	-	1
CO2	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1
CO3	-	-	-	-	1	-	-	-	-	-	-	-	-	1	2	1
CO4	1	-	-	1	1	-	-	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E403ENVIRONMENTAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Microbial Ecology: Basic concept, types of microbial habitats, factors affecting microbial population; microbial interactions; competition, Amenesalism, parasitism, mutualism, commensalisms, synergism; Biogeochemical cycles: Carbon, Nitrogen, Phosphorous and Sulphur Cycle; Conservation and management of microbial diversity.	**15**
Unit II **Microbial diversity in normal environments:** Diversity of microbes in terrestrial (agricultural and desert soils), aquatic (fresh water and marine), atmospheric (stratosphere) and animal (cattle, termites, pests such as cockroach and nematodes, and human being) and their potential applications	**15**
UNIT-III **Microbial diversity in extreme environments:** Occurrence, diversity, adaptations and potential applications of oligotrophs, thermophiles, psychrophiles, barophiles, organic solvent and radiation tolerants, metallophiles, acidophiles, alkaliphiles and halophiles	**15**
UNIT IV Waste treatment: Wastes: types, solid and liquid wastes, treatments: physical, chemical and biological, aerobic and anaerobic, liquid waste treatment: trickling activated sludge, attached films, oxidation ponds and ditches; solid waste treatment. Sccharification, composting.	**15**

Suggested Books:

1. Extremophiles by B.N.Johri, Springer Verlog, New York.
2. Microbial Diversity by D.Cdwd, Academic press.
3. Manual at Environmental Microbiology, 2nd edition, by C.J. Hurst, ASM Press.
4. Microbial Ecology: Fundamentals and Applications, Atlas, RM &Barta, R.
5. Aerobiology, 1997, by Tilak.
6. Environmental Microbiology by Ralph Mitechell.
7. Bioremediation principles by Eweis.
8. Techniques in Microbial Ecology by Buruage.
9. Environmental Microbiology, 1981, by W.P. Grant and P.E. Long

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E404FOOD AND DAIRY MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The students will be familiarized with the apparatus and equipment used in a microbiology laboratory, how to maintain aseptic conditions in microbiological experiments. They will learn to prepare culture media, isolate and culture bacteria and fungi and to extract nematodes. They will learn to study the general morphological features of different microorganisms.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to:

CO1: Student will have knowledge of Microorganisms important in food microbiology & Taxonomical classification of microbes associated with food products

CO2: Are able to understand different intrinsic and extrinsic factors responsible for food spoilage.

CO3: Are able to describe the role of microorganisms in the production of food

CO4: Are able to identify the role of microorganisms in the causation of the diseases and how to protect against food-borne pathogens.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO2	3	1	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO3	3	-	1	1	3	-	-	1	1	3	1	2	-	1	1	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	1	2

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E404FOOD AND DAIRY MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I: Microorganisms important in food microbiology: Taxonomical classification of microbes associated with food products, their phenotypic and biochemical identification. Food associated molds, yeasts, yeast-like fungi and bacteria. Microbiome of food material	**15**
Unit II: **Microbiology of foods:** Microbial habitat of specific food materials, adaptations and changes in microbiome of vegetables, fruits, milk, fermented and non-fermented milk products, fresh meats, poultry and non-dairy fermented foods. **Microbial spoilage of foods:** Types and causes of spoilage of cereals and cereals products, spoilage of vegetables and fruits, spoilage of meat and meat products, spoilage of fish and other sea foods, spoilage of eggs and other poultry products, spoilage of milk and milk products. Study of microorganisms responsible for spoilage and microbial succession during spoilage. Brief insights into chemical and physical spoilage of foods. **Food preservation:** General principles of food preservation, various classical, physical, chemical, and biological methods of preservation. New developments in food preservation techniques. Analysis of practical implementation of such techniques.	**15**
Unit III: **Fermentation processes:** Production of fermented milk and milk products, plant-based products, fish products, meat products and nutraceuticals. Manufacture of starter cultures from lab to pilot scale. Batch submerged and solid-state fermentation of foods. **Food beverages and enzymes**: Concept of human microbiome, probiotics and prebiotics. Insight into health benefits of fermented milk products. Understanding benefits of tradition and non-traditional fermented foods. Introduction to the concept of bioactive compounds and brief study of such compounds from fermented foods including malt beverages, wines, distilled liquors and vinegar.	**15**
Unit IV: **Food-borne diseases:** Food borne infections including bacterial, viral and fungal infections. Study of infections due to food borne parasites. In depth study of various types and causes of food intoxication. Summary of prevention of microbial food infections. Identification and first aid for specific types of food infections.	**15**

Suggested Books:

1. Food Microbiology by W.C. Frazier, D.C. Westhoff , K.N. Vanitha. 5 th edition. McGraw Hill Education. 2013.
2. Modern Food Microbiology by J.M. Jay, M.J. Loessner, D.A. Golden. 7 th edition. Springer. 2006.
3. Fundamental Food Microbiology by B. Rayand A. Bhunia. 5th edition. CRC press. 2013.
4. Food Microbiology by M. R. Adams, M. O. Moss, P. McClure. 4 th edition. Royal Society of Chemistry. 2015.
5. Food Microbiology: Fundamentals and Frontiers by M. P. Doyle, L. R. Beuchat. 3 rd edition. ASM press. 2007.
6. Food Microbiology: An Introduction by T. Montville, K. Matthews, K.Kniel. 4 th edition. ASM press. 2017.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E405AGRICULTURAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The main objective of this course is to impart the basic and advance knowledge about microbiota of soil, biological nitrogen-fixation, plant diseases & their control and new strategies & biotechnology in agriculture

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to:

CO1: Describe microbiota of soil, relationship between soil microorganisms & higher plants and their role in Organic matter decomposition

CO2: Student will have knowledge of Chemical transformation by microbes and mechanism of biological nitrogen-fixation

CO3: Explain causative agents, symptoms & control of important, fungal, bacterial & viral diseases in plants

CO4: Students will be able to evaluate new strategies & biotechnology in agriculture

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	1	1	-	2	-	-	1	2	2	2	2	1	2	-	2
CO2	2	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1
CO3	2	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1
CO4	2	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E405AGRICULTURAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Microbiota of soil, inter-relationship between soil microorganisms & higher plants. Microbial products influencing plant growth. Organic matter decomposition: Degradation of plant residues, humus, mineralization & immobilization process, soil sickness, composting, vermin-composting, green manure, rhizosphere& phylosphere, biogas, biodegradation of pests & pollutants, biofertilizers	**15**
UNIT-II Biological nitrogen-fixation: The range of nitrogen fixing organisms; mechanism of nitrogen fixation (biochemistry of nitrogenase); genetics of nitrogen-fixation. Rhizobium-Legume Association; Symplasmids, N2 fixation by non-leguminous plants. Chemical transformation by microbes: Organic matter decomposition, nutrient mineralization and immobilization; transformation of carbon and carbon compounds.	**15**
UNIT-III Plant diseases & their control: Causative agents, symptoms & control of important, fungal, bacterial & viral diseases of cereal crops, fruits & vegetables, Bacterial- Citrus canker. Fungal- ergot of bajra and rot of sugarcane. Viral- viral diseases of potato.	**15**
UNIT IV New strategies & Biotechnology in Agriculture: The new green revolution, frostcontrol biotechnology, tolerance of herbicides, gene protection technology, biopesticides, bioconversion. patents, tissue culture	**15**

Suggested Books:

1. Agricultural Microbiology by G.Rangaswamy and Bagyaraj, Prentice Hall India.
2. Bio-fertilizers in Agriculture and Forestry, by N.S. SubbaRao.
3. Soil Microbiology and Plant Growth, by N.S. SubbaRao.
4. Sharma, P.D. (2016). Plant Pathology, Rastogi publications
5. Rao, N.S.S. (2015). Soil Microbiology. Oxford & IBH Publishing Co., New Delhi.
6. Jeffery C. Pommerville (2014). Alcamo's Fundamental Microbiology, Jones pub.
7. Ghulam Hassan Dar (2010).Soil Microbiology and Biochemistry
8. Agrios G. N. 2005. Plant Pathology. 5th Edition, Academic Press, San Diego.
9. Christon J. H. 2001. A Manual of Environmental Microbiology. ASM Publications.
10. Forster C. F. & John DA 2000. Environmental Biotechnology. Ellis Horwood Ltd. Publication.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E406PLANT PATHOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objectives of this course are to provide basic understanding of the Concepts and physiology of plant diseases, Biochemical basis of plant diseases, Principles of plant disease control, Molecular diagnosis and transgenic approach for plant protection.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to-

CO1: Student will able to understand concept of Causes of disease, pathogenesis, pathogenesis in relation to environment, effect of microbial infections on plant

CO2: Describe Biochemical and Genetic basis of plant diseases

CO3: Student will be able to explain Principles of plant disease control, physical and chemical methods of disease control

CO4: Student will be to learn the use of Molecular diagnosis, transgenic approach for plant protection, application of molecular diagnosis for disease forecasting.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	-	-	1	1	-	1	-	2	1	1	1	-	2	1	1
CO2	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO3	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO4	1	-	-	1	1	-	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E406PLANT PATHOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT I: Concepts and physiology of plant diseases: Causes of disease, pathogenesis, pathogenesis in relation to environment, effect of microbial infections on plant physiology, photosynthesis, respiration, transpiration, translocation.	**15**
UNIT II: Biochemical basis of plant diseases: Enzymes and toxins in plant diseases, phytoalexins. Some important plant diseases and their etiological studies: Crown gall, symptoms of viral diseases and their control, diseases of some important cereals, vegetables and crops. Genetic basis of plant diseases: Genetics of host-pathogen interactions, resistance genes, resistance mechanisms in plants.	**15**
UNIT III: Disease control: Principles of plant disease control, physical and chemical methods of disease control, biocontrol, biocontrol agents - concepts and practices, fungal agents, Trichoderma as biocontrol agent, biocontrol agents – uses and practical constraints.	**15**
UNIT VII Molecular approach: Molecular diagnosis, transgenic approach for plant protection, futuristic vision of molecular diagnosis, applications and constraints. : Disease forecasting: History and important milestones in disease control, disease forecasting and its relevance in Indian farming.	**15**

Suggested Books:

1. Plant Pathology by G. N. Agrios. 5 th edition. Academic Press. 2005
2. Plant Pathology by R.S. Mehrotra, and A. Aggarwal, 3rd edition. Tata McGraw Hill. 2017
3. Bacterial plant pathology: cell and molecular aspects by D. C. Sigee. Cambridge University Press.1993.
4. Molecular plant pathology by M. Dickinson. BIOS Scientific Publishers, London. 2003.
5. The essentials of Viruses, Vectors and Plant diseases by A.N. Basu& B.K. Giri. Wiley Eastern Limited.1993.
6. Biocontrol of Plant Diseases (Vol. I) by K.G. Mukerji and K.L.Garg. CRC Press Inc.,USA.1988.
7. Molecular Biology of Filamentous Fungi by U. Stahl and P. Tudzyski. VCH Verlagsgesellschaft mbH. 1992. Facilitating the achi

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB- 406 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

CO1. To understand the quality of water using BOD and COD and to determine the potability of water sample

CO2. To provide practical knowledge and skill in the isolation of organisms from contaminated foods

CO3. To acquire hands-on training for the production of fermented products, organic acid, enzymes

CO4. To know the importance of biofertilizers and biopesticides

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	2	-	1	1	2	1	-	2	1	1	1	-	2	1	1
CO2	-	2	-	-	1	2	1	-	-	-	-	-	-	1	2	1
CO3	-	2	-	-	1	2	1	-	-	-	-	-	-	1	2	1
CO4	1	2	-	1	1	2	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-406 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Identification of microbial flora of the mouth-saliva
Experiment No. 2
Identification of microorganisms of the upper respiratory tract- II (Nasopharynx)
Experiment No. 3
Determination of quality of a milk sample by methylene blue reductase test
Experiment No. 4
Production of Ethanol by Immobilized Bakery Yeasts (*Saccharomyces cerevisiae*)
Experiment No. 5
Isolation of antibiotic-producing microorganisms from the soil
Experiment No. 6
Determination of Biochemical oxygen demand (BOD) of water
Experiment No. 7
Determination of Biochemical oxygen demand (COD) of water
Experiment No. 8
Determination of total bacterial population by Standard Plate Count Technique
Experiment No. 9
Identification and microbial examination of food
Experiment No. 10
Production of spawn for white button mushroom (*Agaricus bisporus*)
Experiment No. 11
To understand the principle and process of antibiotic sensitivity (Kirby-Bauer method) in bacteria using minimal inhibitory concentration (MIC) of an antibiotic