

## Microbiology Syllabus for Semester III, IV,

**The goal of the syllabus is** to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

No	paper	Objectives	Outcomes
1	USO3CMIC01	To make the students familiar with: <ul style="list-style-type: none"> <li>• Microbiology as a subject</li> <li>• Various microorganisms (bacteria, viruses, yeast, mold etc)</li> <li>• Discovery of bacteria &amp; Scope of microbiology</li> <li>• Ultrastructure of a bacterial cell and its study using Different type of stains and staining techniques under Microscopes.</li> </ul>	The students will be able to: <ul style="list-style-type: none"> <li>• Differentiate between Prokaryotic and eukaryotic microorganisms</li> <li>• Understand the scope of microbiology (agricultural, medical, industrial, dairy, food, clinical microbiology)</li> <li>• Describe the ultrastructure and organelles of a bacterial cell</li> <li>• Use the knowledge of staining techniques and microscopes in microscopic examination.</li> </ul>
2	USO3CMIC02	To aware the students about: <ul style="list-style-type: none"> <li>• The place of microbes in the living world</li> <li>• The nutritional requirements and physical parameters needed for the cultivation of bacteria</li> <li>• Methods of isolating bacteria and above all their growth</li> <li>• Different types of viruses (bacterial, plant, animal), their structure , cultivation and replication of bacterial viruses</li> </ul>	The students will be able to: <ul style="list-style-type: none"> <li>• Describe the concepts of bacterial classification</li> <li>• Use the knowledge of nutritional requirements and various conditions for cultivation and isolation of bacteria at laboratory level as an applied aspect</li> <li>• Explain the morphology, general characteristics and replication of bacterial viruses</li> </ul>
3	USO4CMIC01	To impart knowledge regarding: <ul style="list-style-type: none"> <li>• Normal flora of humans and gnotobiosis</li> </ul>	The students will be able to : <ul style="list-style-type: none"> <li>• Understand the significance of normal flora</li> </ul>

		<ul style="list-style-type: none"> <li>• Basics of Medical Microbiology</li> <li>• Air flora : their significance and control</li> <li>• How microbes are beneficial at an industrial level for the production of various products</li> <li>• Control of microorganisms both by physical and chemical agents</li> </ul>	<ul style="list-style-type: none"> <li>• Describe the role of microorganisms in causing diseases and their virulence factors</li> <li>• Demonstrate natural resistance to infection</li> <li>• Enumerate microorganisms present in air</li> <li>• Understand the potential of microbes in fermentation of various products especially Alcohol fermentation.</li> </ul>
4	USO4CMIC02	<p>The students should study about:</p> <ul style="list-style-type: none"> <li>• Types of microorganisms found in milk and their sources Milk borne diseases &amp; Dairy products of milk (butter, cheese, fermented milk)</li> <li>• Microbiological examination of milk ,food, water</li> <li>• Microbial spoilage of food and its preservation</li> <li>• Types of water(natural,marine) and its purification, disposal of sewage</li> <li>• The normal flora of soil, interaction of microbes in soil and their role in transformation of nutrients</li> </ul>	<p>The students will be able to:</p> <ul style="list-style-type: none"> <li>• Use the information of milk and water microbiology for microbiological analysis at laboratory level and thereby determine the quality of milk and water samples</li> <li>• Understand the concept of pasteurization</li> <li>• Correlate microbial food spoilage and proper handling of food at home</li> <li>• Demonstrate the significance of microbes in soil fertility and its role in agriculture</li> </ul>

## Microbiology Syllabus for Semester V, VI

No	Paper	Objectives	Outcomes
1	USO5CMIC01	<p>To impart information about:</p> <ul style="list-style-type: none"> <li>• Structure and chemistry of DNA and various forms of DNA.</li> <li>• Types of RNA (rRNA, tRNA, mRNA)</li> <li>• Molecular mechanism of DNA replication, transcription, translation in prokaryotes</li> <li>• Cracking of genetic code</li> <li>• RNA dependent RNA synthesis and RNA dependent DNA synthesis</li> <li>• Regulation of gene expression</li> </ul>	<p>The students will comprehend :</p> <ul style="list-style-type: none"> <li>• The basic components of Nucleic acids.</li> <li>• The basic concepts of flow of genetic information (DNA to RNA to Protein) and how few viruses do not follow the central dogma of gene expression</li> <li>• The synthesis of Nucleic acids and protein with respect to its relationship with ribosomes and genetic code.</li> <li>• How RNA and Proteins are modified after synthesis</li> <li>• How gene expression is regulated at transcriptional level and develop an understanding of operon concept</li> </ul>
2	USO5CMIC02	<p>To familiarize the students with:</p> <ul style="list-style-type: none"> <li>• Principle, applications and working of various instruments like: Spectroscopy (UV visible, mass, IR, atomic absorption), flame photometry, Nephelometry Electrophoresis (PAGE, SDS-PAGE etc)</li> <li>• Centrifugation (Density gradient, ultracentrifugation)</li> <li>• Chromatography (TLC, HPLC, GLC, affinity, ion exchange etc)</li> <li>• Biosensors</li> <li>• Basic concepts of bioinformatics</li> <li>• Nature and types of Radioactivity</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• Describe the significance &amp; use of various instruments as a powerful tool for studying biomolecules like proteins, lipids carbohydrates and nucleic acids from varying samples like bacteria, animal and plant tissues and even clinical samples and food</li> <li>• Explain how separation of molecules from the mixture can be carried out using various techniques.</li> <li>• Know the applications of biosensors in various fields (industrial, medical and clinical ,food , agriculture, environment ) as diagnostic tool.</li> <li>• Understand aim, branches and scopes of bioinformatics</li> <li>• Know the applications of radioactivity and its safety</li> </ul>

			measures
3	USO5CMIC03	<p>To make the students understand:</p> <ul style="list-style-type: none"> <li>• The structure of membrane and the mechanism of nutrient transport. across the membrane in bacteria</li> <li>• The role of siderophore in metal transport and signal sequences for protein secretion</li> <li>• The mechanism of various antibiotics inhibiting microorganisms and resistance to antibiotics</li> <li>• Sporulation and germination of bacterial endospores and mechanism of flagellar movement</li> <li>• Structure ,properties, specificity, Mechanism of action, classification, purification.</li> <li>• Concepts on Zymogens and isoenzymes</li> <li>• Enyme kinetics</li> <li>• Regulation of allosteric enzyme</li> </ul>	<p>Then students will be able to:</p> <ul style="list-style-type: none"> <li>• Conceptualize their understanding of Physiology,biochemistry and enzymology</li> <li>• Explain transport systems of nutrients, metals, proteins in bacteria and the role of bacterial membrane</li> <li>• Gain the knowledge regarding various antibiotics &amp; their mode of action and development of resistance. Explain structure, properties, allosteric sites, active sites and mechanism of enzymes action</li> <li>• Gain knowledge of enzymes and how they work.</li> <li>• Understand enzyme kinetics</li> </ul>
4	USO5CMIC04	<p>To familiarize the students with:</p> <ul style="list-style-type: none"> <li>• Non specific Host defense mechanisms</li> <li>• Cells, tissues and organs of immune system</li> <li>• Specific immune responses</li> <li>• Immune disorders.</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• Explain the importance of immune system</li> <li>• Understand the role of nonspecific host defense mechanisms like cytokines phagocytosis, inflammation etc</li> <li>• Understand the concept and application of monoclonal antibodies</li> <li>• Explain how strategies of immunomodulation can be used to enhance or suppress unwanted immune responses required in hypersensitivity reactions, autoimmune diseases, transplantation</li> </ul>

5	USO5CMIC05	<p>To aware students with :</p> <ul style="list-style-type: none"> <li>• General characteristics, nutrition, reproduction and economic importance of fungi</li> <li>• Growth phases of viruses using various experiments</li> <li>• Characteristics of infectious viruses( HIV, hepatitis, pox), prions and virioids</li> <li>• Diversity in bacteria (Rickettsia, Chlamydia, Mycoplasma, Spirochetes, Actinomycetes, Archaeobacteria etc )</li> <li>• Microbial interactions</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• Differentiate and explain the general characteristics of various type of microbes like fungi, viruses and bacteria</li> <li>• Describe diversity among microbes</li> <li>• Explain the interactions (positive, negative, neutral ) between microbes</li> </ul>
6	USO5CMIC06	<p>To make the students understand :</p> <ul style="list-style-type: none"> <li>• The basis of upstream and downstream processing</li> <li>• The screening processes for selection of industrially important strain</li> <li>• Gene manipulation for strain improvement</li> <li>• Characteristics of fermentation medium, role of precursors, inhibitors, and inducers in its formulation</li> <li>• Fermentor design &amp; types of Fermentor and fermentation (submerged, solid state)</li> <li>• Factors( temperature, pH, DO ,foam ) affecting fermentation</li> <li>• Importance of sterilization of medium and air ,method utilizes for sterilization</li> <li>• Ideal inoculums development.</li> <li>• Oxygen transfer &amp; Factors affecting kla</li> <li>• Scaleup and scaledown</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• Understand the basic principles of microbiology associated with the production and recovery of industrially important products</li> <li>• Enlist important characteristics associated with screening of industrially important strains</li> <li>• Demonstrate the understanding to manipulate the screened strains for its improvement and isolation.</li> <li>• Understand the principles underlying design of fermentor, fermentation process, monitoring and control of process parameters</li> <li>• Explain significance of various conditions like sterilization (medium,air ),inoculums development, OTR etc</li> <li>• Describe factors affecting kla and also sampling</li> <li>• Understand scale up and scale down</li> </ul>

No	Paper	Objectives	Outcomes
1	USO6CMIC01	<p>To make students understand:</p> <ul style="list-style-type: none"> <li>• Mutations, types of mutations, mutants, mutagens &amp; their mode of action, co-relation between mutagenicity and carcinogenicity.</li> <li>• How damages caused to DNA can be repaired in bacteria</li> <li>• Molecular basis of the processes that occur during recombination</li> <li>• Various ways of gene transfer among prokaryotes (transformation, transduction, conjugation) and how it can be used in gene mapping</li> <li>• About transposable elements and plasmids</li> </ul>	<p>The students will comprehend :</p> <ul style="list-style-type: none"> <li>• The basis of evolution in bacteria (mutation, gene transfer, and transposable elements)</li> <li>• The effects of mutation on nucleic acids and how mutants can be isolated</li> <li>• Various repair mechanisms of damaged DNA</li> <li>• Different ways of gene mapping</li> <li>• Significance of different types of bacterial plasmids</li> </ul>
2	USO6CMIC02	<p>To illustrate the students about:</p> <ul style="list-style-type: none"> <li>• Isolation and sequencing of nucleic acids</li> <li>• Enzymes ,Vectors and their role in r- DNA technology</li> <li>• C-DNA library preparation</li> <li>• Methods (transformation, transfection, transduction, electroporation, particle gun) of introducing rDNA in host and selection of r-clones (colony hybridization, marker inactivation ,reporter genes)</li> <li>• Southern and northern hybridization.DNA footprinting and DNA fingerprinting</li> <li>• Labeling of probes, genetic markers, microarray</li> <li>• Protein sequencing(Edman’s method) &amp; PCR technique</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• The creative use of modern tools and techniques for manipulation and analysis of gene</li> <li>• Understand the role of restriction endonucleases in In r- DNA technology</li> <li>• Describe the importance of plasmid , lamda phage , cosmid ,BAC and YAC vectors in construction of chimeric DNA</li> <li>• Distinguish between the techniques of selection and screening of r-clones</li> <li>• Explain how DNA and RNA can be detected and the role of probes</li> <li>• Comprehend how to detect the protein bound region on DNA</li> </ul>

			<ul style="list-style-type: none"> <li>Describe the significance of PCR in DNA fingerprinting and its role in forensic science</li> <li>Know the significance of DNA and proteins sequencing as well as microarray</li> </ul>
3	USO6CMIC03	<p>To familiarize the students with :</p> <ul style="list-style-type: none"> <li>Metabolism of carbohydrate, lipid and protein</li> <li>Structure, role, and modes of ATP generation in bacteria</li> <li>Pathways (EMP ,DD ,PP) and cycles ( TCA cycle, glyoxylate, Calvin Benson, urea) involved in metabolic reactions</li> <li>Oxidation reactions (<math>\alpha</math>, <math>\beta</math>, <math>\omega</math>)for metabolism of saturated and unsaturated fatty acids (mono and poly)</li> <li>Other reactions ( stickland, transamination and oxidative deamination, anapleurotic, photophosphorylation, phosphorylation )</li> <li>Regulatory mechanisms ( TCA and glycolysis )</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>Explain metabolic processes with respect to lipids, carbohydrate, proteins</li> <li>Describe the structure, role and generation (oxidative phosphorylation, substrate level phosphorylation, photophosphorylation in bacteria) of ATP</li> <li>Explain pathways for degradation (EMP, PP, ED ) and biosynthesis of glucose (gluconeogenesis, CO<sub>2</sub> fixation)</li> <li>Understand oxidation &amp; biosynthesis of fatty acids.</li> <li>Describe biosynthesis &amp; catabolic reactions of amino acids and biosynthesis of peptidoglycan</li> </ul>
4	USO6CMIC04	<p>To familiarize the students with :</p> <ul style="list-style-type: none"> <li>Blood &amp; blood banking,</li> <li>Methods of diagnosis of clinical specimens</li> <li>The techniques and test in clinical microbiology (ELISA, RIA, immunodiffusion, western blot, immunofluorescence, immunoelectrophoresis)</li> <li>Epidemiology of infection</li> </ul>	<p>The students will be able to:</p> <ul style="list-style-type: none"> <li>Describe blood, its components &amp; blood groups</li> <li>Conceptualize the principles of blood banking.</li> <li>Explain the methods relevant to collection, transport, storage of</li> </ul>

		<ul style="list-style-type: none"> <li>• Role of vaccines</li> <li>• The symptoms, virulence and transmission, diagnosis, treatment and prevention of various diseases</li> </ul>	<p>clinical specimens</p> <ul style="list-style-type: none"> <li>• Describe the methods for the examination of clinical specimens for identification of microbial pathogens</li> <li>• Explain the principles underlying various immune techniques like ELISA, RIA, etc.</li> <li>• Understand infections caused by different bacteria &amp; viruses and the significance of vaccines</li> </ul>
5	USO6CMIC05	<p>To make the students aware of :</p> <ul style="list-style-type: none"> <li>• Microbial nitrogen fixation</li> <li>• Biofertilizers, bioinsecticides Bioleaching, Biodeterioration Bioremediation</li> <li>• MEOR</li> <li>• Xenobiotics and recalcitrance</li> <li>• Biomagnifications, Biodegradation of pollutants &amp; Biodegradable polymers</li> <li>• Biofuels ,their advantages and disadvantages</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• Demonstrate that microbes have an indispensable role in environment and agriculture</li> <li>• Correlate the process of nitrogen fixation and use of microbes as fertilizers</li> <li>• Explain the significance of microbes as insecticide</li> <li>• Describe metal (copper) leaching from ores</li> <li>• Discuss deterioration of important products by microbes</li> <li>• Explain the remediation of harmful compounds. Discuss the recovery of oil using microbes</li> <li>• Explain about nondegradable and persistent substances</li> <li>• Understand the importance of energy sources like biofuels and biogas</li> </ul>



6	USO6CMIC06	<p>To make the students understand :</p> <ul style="list-style-type: none"> <li>• The downstream processing and criteria for selecting an appropriate recovery process</li> <li>• Separation( centrifugation, filtration) of cells, microbial cell disruption</li> <li>• Liquid-liquid extraction and product concentration( precipitation, reverse osmosis, ultracentrifugation)</li> <li>• Quality control, bioassay, methods of immobilization of enzymes and economics of fermentation</li> <li>• Fermentative production of beer vinegar, cheese, baker's yeast, glutamic acid, gluconic acid, cyanocobalamin acetone- butanol, ethanol, <math>\alpha</math>-amylase and penicillin</li> </ul>	<p>The students will be able to :</p> <ul style="list-style-type: none"> <li>• Understand the basic principles of microbiology associated with the production and recovery of industrially important products</li> <li>• Understand the fundamentals of quality control techniques carried out on raw materials and final products</li> <li>• Demonstrate an understanding of bioprocess technology</li> <li>• Discuss production of various microbially fermented products with a representative of different categories like beverages, preservatives, vitamins, alcohols, ketones, enzymes, antibiotics.</li> </ul>
---	------------	---	--

GENERAL OUT COME OF THE COURSE :

- 1) To make the students knowledgeable with respect to the subject and its practicable applicability.
- 2) To promote understanding of basic and advanced concepts in microbiology.
- 3) To expose the students to various emerging areas of Microbiology.
- 4) To prepare students for further studies, helping in their bright career in the subject.
- 5) To expose the students to different processes used in industries and in research field.
- 6) To develop their ability to apply the knowledge of microbiology in day to day life.
- 7) To prepare the students to accept the challenges in life sciences.
- 8) To develop skills required in various industries, research labs and in the field of human health.

