Department: MICROBIOLOGY

Programme Specific Outcomes (FYGUP-Old)

Programme offered by the Department	**Programme Outcomes**
B.SC MAJOR	• The course aim to inculcate interest with critical and analytical based understanding of the subject with encouragement and scope for creative learning. • The course is helpful in advancing the understanding and impact of Microbiology by connecting and empowering the transition of resource based communities to an intellectually vibrant knowledge based communities. • Ensuring an atmosphere conducive to teaching and learning process. • Boostingstudent'sconfidence in preparingfor the hyper-competitive world. • Holistic intellectual development of young adults enrolled as students. • Providing Quality Higher Education and taking care of intellectual, social, economic needs of students. • Adopting student-friendly approaches to reaching and learning as far as practicable. • Igniting interests in students not only in their subjects but also in related fields and help them ramify and diversify areas of interest. • Encouraging participation of faculty in discussions to teach students with different learning paces for heterogeneous group of students. • Promotion of leadership qualities by promoting soft skills. • Taking periodic feedbacks of students. • To develop excellence in academics.
B.SC MINOR	• The course is helpful in advancing the understanding and impact of Microbiology by connecting and empowering the transition of resource based communities to an intellectually vibrant knowledge based communities. • Ensuring an atmosphere conducive to teaching and learning process. • Boosting student'sconfidence in preparingfor the hyper-competitive world. • Holistic intellectual development of young adults enrolled as students. • Providing Quality Higher Education and taking care of intellectual, social, economic needs of students. • Adopting student-friendly approaches to reaching and learning as far as practicable.

B.SCMDC	• The course is helpful in advancing the understanding and impact of Microbiology • Ensuring an atmosphere conducive to teaching and learning process. • Boosting student's confidence in preparing for the hyper-competitive world. • Holistic intellectual development of young adults enrolled as students. • Adopting student-friendly approaches to reaching and learning as far as practicable.

Course Outcomes FYGUP-2023 (Old)

B.SC MAJOR			
Semester	Course Code	Course Title	Outcome
I	1. UMICMAJ11001	1. Introduction to Microbiology & Microbial Diversity	**1. Course Objective:** The aim of this course is to familiarize the students with the elementary history of the subject Microbiology and the various theories proposed for Microbial existences which are used in understanding the basics of Microbiology in general. The core course will also help to describe the world-changing scientific contributions of pioneering scientist of the 17^{th} to 18^{th} century. The core course will help the students to understand the importance of morphological distinctness with respect to species diversity of Algae, Fungi and Protozoa and their Evolutionary relationship that exist in between them. They will try to critically think why algae, fungi and protozoa are studied in Microbiology. Moreover, core course will also provide a comprehensive understanding of the origin of various techniques used in Microbiology and development of ideas to exhibit the techniques origin and development of ideas to exhibit the techniques for isolation of pure culture. **Learning Outcome:** After successful completion of this course students will be able to:

			➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Describe the contributions of eminent pioneer microbiologist, Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky and Selman A. Waksman in the establishment of the field of Microbiology. ➢ Describe the evidence that support the Germ theory of disease. ➢ Define microbes in the words of Leeuwenhoek and as we know them today. ➢ Explain why protozoa, algae, and non-microbial parasitic worms are studied in microbiology. ➢ List and answer four questions that propelled research in what is called the "Golden Age of Microbiology." ➢ Identify the scientists who argued in favour of spontaneous generation. ➢ Compare and contrast the investigations of Redi, Needham, Spallanzani, and Pasteur concerning spontaneous generation. ➢ List four steps in the scientific method of investigation. ➢ Discuss the significance of Pasteur's fermentation experiments to our world today. ➢ Explain why Pasteur may be considered the Father of Microbiology. ➢ Identify the scientist whose experiments led to the field of biochemistry and the study of metabolism. ➢ List at least seven contributions made by Koch to the field of microbiology ➢ List four groups of algae, and describe the distinguishing characteristics of each ➢ List the four steps that must be taken to prove the cause of an infectious disease. ➢ Describe the contribution of Gram to the field of microbiology. ➢ Identify six health care practitioners who did pioneering research in the areas of public health microbiology and epidemiology. ➢ Name two scientists whose work with

			vaccines began the field of immunology. ➢ List four major questions that drive microbiological investigations today. ➢ Identify the field of microbiology that studies the role of microorganisms in the environment. ➢ Name the fastest-growing scientific disciplines in microbiology today. ➢ List the economically important group of Algae, Fungi and Protozoa ➢ Describe the ultrastructure of viruses ➢ List several economic benefits derived from algae. ➢ List four ways in which water moulds differ from true fungi ➢ Describe the five kingdom system of classification
	2. UMICSEC11001	2. Biotechniques & Biostatistics	2. The course objective of biostatistics is to equip students with the fundamental knowledge and skills to apply statistical methods in the analysis, interpretation, and presentation of biological, medical, and health-related data. Specific Objectives: 1. Understand Basic Concepts: Explain the basic principles of biostatistics and its role in health sciences. 2. Data Collection & Organization: Learn methods of data collection, classification, and presentation. 3. Descriptive Statistics: Apply measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation). 4. Probability & Distributions: Understand probability concepts and statistical distributions (Normal, Binomial, Poisson). 5. Inferential Statistics: Perform hypothesis testing, confidence intervals, and p-value interpretation. 6. Correlation & Regression: Analyze relationships between variables using correlation and regression techniques. 7. Statistical Tests: Apply t-tests, chi-square tests, and ANOVA for data analysis. 8. Software Usage: Use statistical software (such as SPSS, R, or Excel) for data analysis. 9. Research Application: Interpret statistical results in biological and health research. 10. Critical Thinking: Evaluate statistical findings and their relevance to public health and clinical studies. This course helps students develop the ability to make data-driven decisions in health sciences and research. Outcome: i) Fundamental knowledge on principles & applications

			of various biotechniques ii) Laboratory Skills in using biotechniques for biological sample analysis iii)Data analysis applying statistical tools for data collection, interpretation and presentation in biological research iv)Experimental Design & performing statistical tests v) Problem solving approach
II	1. UMICMAJ12002	1. Bacteriology	1. The objective of the Bacteriology paper is to acquaint the student with the basic concepts of bacteriology for the development of the right attitudes by the Microbiology students to better understand the theoretical aspects of Bacteriology. The course is also intended to provide a thorough background on the anatomical and cellular organisation of the basic fundamental unit of all living organisms called cell. The course will also help the student to understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also understand the structural similarities and differences among various physiological groups of bacteria/archaea. The student will be able to understand various physical and chemical means of sterilization, historical background of culture growth media and their applications. Know more about various microbial techniques for the isolation of pure cultures in an artificial growth media along with the safe laboratory practices. Moreover, the topics also provide an opportunity to understand the importance of three distinct Domain system of life (Eubacteria, Archaebacteria and Eukaryotes). The coverage of important archaeal and eubacterial groups has been expanded and updated for coherent understanding. **Learning Outcome:** After successful completion of this course students will be able to: ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Describe the cellular organisation of prokaryotic and eukaryotic cells ➢ Differentiate the cell wall characteristics of Gram Positive and Gram Negative Bacteria ➢ Describe the importance of differential staining procedure: Gram and Acid fast staining ➢ Describe the importance of differential staining procedure in medical microbiology ➢ Describe the importance of Archaebacteria ➢ List two structures that are unique to Gram-negative and to Gram-positive cells, and provide the function of each.

			➢ List two structures that both Gram-negative and Gram-positive cells have in common, and provide the function of each. ➢ ➢ Comment on the cell wall characteristics of Archaebacteria ➢ Describe the effect of antibiotic on the growth of prokaryotic organisms with respect to cell wall architecture ➢ Differentiate the plasma membrane structure of archaea and prokaryotic organism ➢ Comment on the Ribosome of Prokaryote and Eukarya ➢ Describe the process of sporulation in Gram positive bacteria ➢ State two unique structures present in Eukaryotes, but not in Bacteria and Achaea. ➢ Describe the structure of endospore ➢ List the various stages of endospore formation ➢ List the methods of pure culture isolation ➢ Describe the various methods of pure culture isolation ➢ List the important technique available for maintaining the pure culture for short term and long term preservations ➢ How can anaerobic bacteria be brought into culture growth ➢ State the difficulties faced by microbiologist in isolating pure culture ➢ Describe the various methods available in determining non-cultural bacteria. ➢ List the various types of Microscope used in the field of Microbiology ➢ Describe the mechanical part and functioning of Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope ➢ Explain why microscope is used in Microbiology ➢ Describe the nutritional requirements in bacteria ➢ List the various type of media used in microbiology ➢ What is a culture and culture media ➢ Classify various types of media based on function and composition ➢ How can bacterial growth be enriched ➢ Describe the physical and chemical methods of sterilization ➢ Explain the mode of action biocides for controlling microorganisms ➢ Describe the general process of asexual

			reproduction ➢ Explain the logarithmic increase in growth ➢ Describe the various phases of growth ➢ Calculate the mean generation time and specific growth rate constant ➢ List the three Domains of the phylogenetic tree of life. State a unique characteristic of each Domain ➢ List two features of a useful molecular/evolutionary clock. ➢ Explain what features of 16S rRNA make it useful to compare the evolutionary relationship between organisms. ➢ Determine the two most related and two least related organisms from a short list of 16S rRNA sequences. ➢ Draw inferences about evolutionary relatedness of organisms based on phylogenetic trees. ➢ Describe the general characteristics of the different members of Archaebacteria ➢ Describe the overall features related to alpha, beta and gamma proteobacteria ➢ Describe extensively the features of low G+C Firmicutes ➢ Describe extensively the features of high G+C Actinobacteria ➢ Briefly describe the important cellular features associated with cyanobacteria ➢ Explain the role of heterocyst in nitrogen fixation
	2. UMICSEC12002	2. Biofertilizers	2. i) Understanding Biofertilizer types and knowledge of various biofertilizers like nitrogen fixing, phosphate solubilizing and composting microbes. ii) Microbial interaction in soil. The beneficial role of microbes. iii) Production Techniques; isolation, production and mass multiplication of biofertilizer starins iv) Application Method; field application of biofertilizer v) Environmental Sustainability The purpose of this course is to introduce the students the basics of biofertilizer and biopesticides. Biofertilizers supplement the requirements of fertilizers and do not replace them. The use of biofertilizers is being emphasized along with chemical fertilizers and organic manures.Biofertilizers are live products (or latent cells of microbes) and require care in storage, transport, application and maintaining field conditions. Applied to seed/seed material/seedlings/soil/waste matter/crop residues in order to increase the population. Accelerate some biochemical processes.

			Learning Outcome: ➢ How biofertilizers are used for various crop plant productionand their advantages ➢ Development of integrated management for best results uses both nitrogenous and phosphatic biofertilizers ➢ Make more nutrients available to the crops ➢ How microbes are used as bioinsecticides and their advantages over synthetic pesticides
III	1. UMICMAJ23003	1. Biochemistry	1. Biochemistry is an evolving science where researchers are making new discoveries every day. The objective of this course is to teach students the fundamentals concepts in biochemical chemistry and thermodynamics. Enable student to 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. The student will be able to incorporate these concepts into their basic learning of chemical structures needed for understanding of chapter in other courses where basic chemical are used as a precursor for the generation of biological macromolecules i.e., integration of metabolism with biochemistry. The biochemistry course has been designed to meet up the fundamentals required for understanding the chemical biology of microbes and human health. Finally to give an overview of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, vitamins, enzymes, their classification, structure, and function will be dealt in details. The fundamental and conceptual knowledge of properties, structure, and function of enzymes, enzyme kinetics and their regulation will be covered using models. **Learning Outcome:** After successful completion of this course students will be able to: ➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Explain the two laws of Thermodynamics ➢ Define Gibb's Free Energy, enthalpy, and Entropy and establish mathematical relationship among them. ➢ Describe standard free energy change and equilibrium constant and Coupled reactions and additive nature of standard free energy change ➢ Describe the structure and importance of energy rich compounds: Phosphoenolpyruvate, 1,3-Bisphosphoglycerate, Thioesters andATP ➢ Give a concise account on the classification

			of carbohydrates ➢ Describe the various types of isomerism exhibited by the carbohydrates ➢ Describe mutarotation with respect to monosaccharides ➢ Contrast reducing and non-reducing sugars ➢ Explain Haworth projection formulae for glucose ➢ Describe the chair and boat forms of glucose ➢ List the different types of monosaccharides ➢ Describe the structure of sugar derivatives ➢ Explain the concept of reducing and non-reducing sugars ➢ Describe the structural and storage polysaccharides citing biological examples ➢ Define major classes of lipids ➢ Classify lipids on the basis carbon chain ➢ Explain saponification with respect to hydrolysis of triglycerides ➢ Comment on structural lipids ➢ Give few examples of saturated and unsaturated fatty acids ➢ Describe the functions of lipids ➢ Define amino acids and proteins ➢ Explain the concept of Zwitterions ➢ Describe the titration curve of amino acids and its significance ➢ Classify amino acids on the basis of side groups ➢ Classify the different level of organisation of protein structure ➢ Describe the structure and functions of naturally occurring glutathione and insulin and synthetic Aspartame ➢ Describe in details the structure of Human Haemoglobin ➢ List the different types of forces that hold the protein structure ➢ Define enzyme ➢ Classify enzymes according to enzyme commission number ➢ Explain the following: Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD,metal cofactors ➢ Describe the mechanism of action of enzymes: active site, transition state complex and activation energy. ➢ Explain the Lock and key hypothesis, and Induced Fit hypothesis ➢ Describe the significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism ➢ Give a definitions of terms – enzyme unit, specific activity and turnover number, ➢ Describe multienzyme complex : pyruvate

			dehydrogenase; isozyme: lactate dehydrogenase ➢ Explain the effect of pH and temperature on enzyme activity ➢ Describe enzyme inhibition: through competitive- sulfa drugs; non-competitive- heavy metal salts ➢ Classify and characterise vitamins with suitable examples, sources and importance
	2. UMICMAJ23004	2. Microbial Physiology & Metabolism	2. **Course Objective:** This course is offered to students to understand the basic of bacterial metabolism and nutrient translocation. The chapter included in the course will be helpful for the student to know the nutritional requirements needed for the biosynthesis and energy yielding and energy-conserving process of each nutritional type. The concept of microbial metabolism is presented by discussing the chemical reaction mainly the redox reaction for understanding the interconnected biochemical pathways used by the cells. Moreover, the coverage of nitrogen metabolism is expanded and updated for better physico-chemical understanding of nitrogen fixation by Nitrogen fixing organisms. **Learning Outcome:** After successful completion of this course students will be able to: ➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Describe binary fission as a means of reproduction. ➢ Explain what is meant by the generation time of bacteria. ➢ Describe logarithmic growth. ➢ Draw and label a bacterial growth curve. ➢ Describe what occurs at each phase of a population's growth. ➢ Explain how a chemostat can maintain a microbial culture in a continuous phase. ➢ Contrast direct and indirect methods of measuring bacterial reproduction ➢ Name the five phases of bacterial batch

			culture growth, and describe what the cells are doing during each phase. ➢ Describe the mathematical expression of growth ➢ Describe the viable and non-viable growth attributes ➢ Explain the importance of batch and continuous culture ➢ Compare and contrast synchronous growth, diauxic growth ➢ Explain the concept of diauxic growth. ➢ Describe the various physical factors that influence growth ➢ Define thermophilic, psychrophilic, psychrotolerant, mesophilic, halophilic, acidophilic, alkalophilic, etc., organisms. ➢ Classify organism on the basis of temperature requirements ➢ Classify organism on the basis of pH requirements ➢ Classify organism on the basis of salt requirements ➢ Classify organism on the basis of oxygen requirements ➢ Classify organism on the basis of pressure requirements ➢ Differentiate autotroph with heterotroph ➢ Classify the organism on the basis of carbon requirements ➢ Compare and contrast Passive and facilitated diffusion ➢ Explain the mechanism of group translocation ➢ Define uniport, symport and antiport ➢ Describe the microbial growth and effect of environment on microbial growth ➢ Describe the concept of nutrient uptake and transport. ➢ Explain the concepts of aerobic respiration, anaerobic respiration and fermentation and various intermediary mechanism involved. ➢ Explain the pentose phosphate pathway with molecular structure and enzymes involved ➢ Comment on the various sugar degradation pathways ➢ Describe with flow diagram , EMP,ED, TCA cycle and electron transport phosphorylation ➢ What are uncouplers and inhibitors ➢ Describe anaerobic respiration with special reference to dissimilatory nitrate reduction ➢ Give a flow diagram of lactate fermentations ➢ Explain the importance of metabolic

			pathways in case living organism ➢ Give the importance of linear and branched fermentation pathways ➢ Describe the pathway related to alcohol production ➢ List two differences between substrate-level phosphorylation and oxidative phosphorylation. ➢ Explain the importance of chemolithotrophic group of organisms ➢ Explain the role of hydrogen and methane producing bacteria ➢ Describe the process of methanogenesis in terms of electron transport and energy generation ➢ What are the various mode of photosynthesis available in case of bacteria ➢ List the important bacteria capable of carrying out bacterial photosynthesis ➢ Give a redox diagram to explain the anoxygenic photosynthesis in case of Purple and Green Bacteria ➢ Give a redox diagram related to oxygenic photosynthesis ➢ Describe the concept of photosynthesis with relation to light harvesting molecules ➢ Explain the importance of cyclic photophosphorylation ➢ Compare and contrast photosynthesis in cyanobacteria and purple or green bacteria ➢ Describe the process of biological nitrogen fixation with respect to nitrogen fixing group of organisms ➢ Explain the importance of assimilatory and dissimilatory nitrate reduction ➢
	3. UMICMAJ23005	3. Food & Dairy Microbiology	3. Learning outcome: ➢ Students will gain knowledge about microbiology of milk and fermented products. ➢ Students will also know the microbial quality control and quality schemes used in food industries. ➢ To understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in food and dairy. ➢ To know the spoilage mechanisms in foods and dairy and thus identify methods to control deterioration and spoilage ➢ To recognize and describe the characteristics of important pathogens

			and spoilage microorganisms in foods and dairy. ➢ To learn various methods for their isolation, detection and identification of microorganisms in food and dairy. ➢ To understand of the basis of food safety regulations and discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food and dairy. After successful completion of this course students will be able to: ➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ To list the different types of fermented foods ➢ State the health benefits advantages of fermented foods ➢ To learn the various types of milk based fermented foods like Dahi, Yogurt, Buttermilk (Chach) and cheese ➢ Describe the importance of cereal based fermented foods ➢ To learn the production methods of Soy sauce, Bread, Idli and Dosa ➢ To learn the production methods and microorganisms involved in Pickels, Saeurkraut ➢ To learn the basic of fermented meat and fish products ➢ To learn the importance of probiotics in promoting health benefits
	4. UMICSEC23003	4. Microbial Quality Control in Food Industries	**4.** Students will be able to learn about the isolation, maintenance, improvement processes of various industrially important strains and how they are used for mass production of industrially important products such as antibiotics, vitamins, enzymes, including enzyme immobilization. After successful completion of this course students will be able to: . ➢ To list the different types of fermented foods ➢ State the health benefits advantages of fermented foods ➢ To learn the various types of milk

			based fermented foods like Dahi, Yogurt, Buttermilk (Chach) and cheese ➢ Describe the importance of cereal based fermented foods ➢ To learn the production methods of Soy sauce, Bread, Idli and Dosa
IV	1. UMICMAJ24006	1. Molecular Biology	**1. Course Objective:** Eubacteria and Eukaryotes genome replication and expression are considered together in this course. In both cases, the topics has been updated and expanded, and reflects the comparative information flow as carried out by members of Eubacteria and Eukaryote. It will enable the students to know the terms and terminologies related to molecular biology. It will help student to understand the properties, structure and function of genes at the molecular level. To discuss the molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair mechanisms along with the molecular mechanism involved in Replication, Transcription and Translation and the enzymes, accessory proteins involved in it. **Learning Outcome:** After successful completion of this course students will be able to: ➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Know the terms and terminologies related to molecular biology and microbial genetics ➢ Explain Griffith's classic experiment with rough and smooth cells. Describe the relationship between capsule genes and virulence. ➢ Understand the properties, structure and function of genes in living organisms at the molecular level ➢ Explain the significance of central dogma of gene action ➢ Have a conceptual knowledge about DNA as a genetic material, enzymology, and replication strategies ➢ Compare and contrast prokaryotic and eukaryotic chromosomes. ➢ Describe the replication of DNA as a semiconservative process. ➢ Compare and contrast the synthesis of leading and lagging strands in DNA replication.

			➢ Contrast bacterial DNA replication with that of eukaryotes. ➢ State the central dogma of genetics, and explain the roles of DNA and RNA in polypeptide synthesis. ➢ Describe the structure of DNA, and its importance as genetic material. ➢ Describe three steps in RNA transcription, mentioning the following: DNA, RNA polymerase, and promoter, 5' to 3' direction, terminator, and Rho. ➢ Contrast bacterial transcription with that of eukaryotes. ➢ Describe the genetic code in general, and identify the relationship between codons and amino acids. ➢ Describe the synthesis of polypeptides, identifying the roles of three types of RNA. ➢ Contrast translation in bacteria from that in eukaryotes. ➢ Explain the operon model of transcriptional control in prokaryotes. ➢ Contrast the regulation of an inducible operon with that of a repressible operon, and give an example of each. ➢ Understand the molecular mechanisms involved in transcription and translation ➢ Describe the importance of genetic code and wobble hypothesis ➢ Explain the role of post transcriptional mRNA processing in Eukaryotes ➢ Explain the translation process of eukaryotes and prokaryotes ➢ Describe the molecular mechanism of sporulation ➢ Describe the DNA methylations mechanism ➢ Describe the histone acetylation mechanism
	2. UMICMAJ24007	2. Virology	2. **Objective:** This course is offered to students to gain basic knowledge on Introduction to Virology and is followed by an exploration of theories of viral origin. The Virology course is designed in a lucid manner outlining the essential morphological architecture, physiological, and genetic elements of viruses as well as viroids, satellites, and prions. They will also know how viruses are classified. The concept of interferon, proto-

			oncogenes is presented and their updated discussion of the role of viruses in causing cancer shall be discussed in detail. **Learning Outcome:** After successful completion of this course students will be able to: ➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Define viruses and label its different parts ➢ Describe the importance of viruses ➢ Give a general characteristics of viruses ➢ Give an examples of double stranded single stranded DNA/RNA virus ➢ Explain the importance of different theories of viral origin ➢ Describe the various methods available for isolation, purification and cultivation of viruses ➢ Contrast non-enveloped and enveloped viruses ➢ What are the possible ways available for the classifications of viruses ➢ Describe the structure of lambda phage virus ➢ Compare and contrast DNA and RNA viruses ➢ Compare and Contrast Plant and animal Viruses ➢ Explain in details the one step growth curve ➢ Describe the life cycle patterns of lambda phage ➢ Describe the role of molecular switches in regulating lytic and lysogenic cycles ➢ Compare and contrast the differences between lysogenic and latent viral infections ➢ Explain the various modes of Persistent, non-persistent, vertical and horizontal viral transmissions ➢ List the salient features of viral nucleic acids with respect to Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV) ➢ Know how viruses are classified ➢ Understand the architecture of viruses ➢ Know the methods used in studying viruses ➢ Classify the virus on the basis of replication

			strategies of representative viruses from the seven Baltimore classes ➢ Understand the interactions between viruses and the host immune system ➢ Describe the terms Oncogenes and tumor suppressor genes, and how tumor viruses interact with these products and their intersecting pathways and cause oncogenesis. ➢ Explain the term oncogenic with respect to viruses ➢ Differentiate between oncogenes and protooncogenes ➢ Give a concise account of oncogenic DNA and RNA viruses ➢ Describe the importance of antiviral compounds and their mode of action ➢ Explain vaccine strategies and mechanisms of antiviral drugs and Interferons ➢ What are interferon and comment on their mode of action ➢ Know how viruses can be used as tools to study biological processes , as cloning vectors and for gene transfer.
	3. UMICMAJ24008	3. Industrial Microbiology	3. The course will help the student to appreciate the importance of microbes and its utility in industrial processes. Additionally, the substrate and type of microbes to be employed in microbiological industries and its safety regulation shall be dealt extensively. The course will also focus on the types of fermentation processes and the methods for the optimization of fermented products. **Learning Outcome:** After successful completion of this course students will be able to: ➢ Will understand brief history and developments in industrial microbiology ➢ List industrially important microbes ➢ Demonstrate the learning how industrially important microbes are isolated.

			➢ Acquire a fairly good knowledge of how microbes and various media are used in the fermentative production of organic acids, alcohols, enzymes, antibiotics and various foods in the industry. ➢ Explain the importance of static and submerged fermentation processes using both the synthetic and organic crude substrates. ➢ Describe different components of typical bio-reactors ➢ Explain the importance of various parameters like pH, temperature, dissolved oxygen, foaming, and its optimization in relation to bio-reactors. ➢ Acquire knowledge of various physical parameters which affect production of industrial products by the microorganisms and the safety aspects of the production and use of these products. ➢ Develop laboratory skills in producing alcohol and enzymes by fermentative process using bacteria/yeast ➢ Understand the importance of batch, fed-batch and continuous fermentation. ➢ Synthesize knowledge on the down streaming process of important organic acid, alcoholic beverages, enzymes and antibiotics. ➢ Understand the knowhow of industrial process of enzyme immobilization.

B.SC MINOR			
Semester	Course Code	Course Title	Outcome
I			
II	UMICMIN10001	Microbial Diversity & Bacteriology	The aim of this course is to familiarize the students with the elementary history of the subject Microbiology and the various theories proposed for Microbial existences which are used in understanding the basics of Microbiology in general. The core course will also help to describe the world-changing scientific contributions of pioneering scientist of the 17th to 18th century. The core course will help the students to understand the importance of morphological distinctness with respect to species diversity of Algae, Fungi and Protozoa and their Evolutionary relationship that exist in between them. Describe the contributions of eminent pioneer microbiologist, Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky and Selman A. Waksman in the establishment of the field of Microbiology. The Purpose of the lab course is to introduce students to the various types of instruments used in microbiology laboratory. They will learn to take weight measurements using electronics balance for preparing microbial media and reagents required in laboratory along with the art of sterilization using autoclaves,and hot air oven. The main objective of this subject is to help students identify the different latest measurement and sterilization techniques available for specific microbiological applications. Lastly, the course is so designed to provide greater safety awareness and to alert students to potential hazards in performing certain experiments in working laboratory.
III			
IV	UMICMIN20002	Biochemistry & Microbial Metabolism	1.The biochemistry course helps students to acknowledge the fundamentals required for understanding the chemical biology of microbes and human health. Students will be able to incorporate these concepts into their basic learning of chemical structures that are used as a precursor for the generation of biological macromolecules i.e. integration of metabolism

			with biochemistry. This course includes the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions. It gives an overview of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, vitamins, enzymes, their classification, structure, and function will be dealt in details along with fundamental and conceptual knowledge of properties, structure, and function of enzymes, enzyme kinetics and their regulation will be covered using models. This course is offered to students to understand the basic of bacterial metabolism and nutrient translocation. The chapter included in the course will be helpful for the student to know the nutritional requirements needed for the biosynthesis and energy yielding and energy-conserving process of each nutritional type. Microbial metabolism is the means by which a microbe obtain the energy and nutrients it needs to love and reproduce. After successful completion of this course students will be able to: ➢ Explain what is meant by the generation time of bacteria. ➢ Explain the concept of diauxic growth. ➢ Classify organism on the basis of temperature, pH, salt, oxygen requirements ➢ Explain the concepts of aerobic respiration, anaerobic respiration and fermentation and various intermediary mechanism involved. ➢ Explain the pentose phosphate pathway with molecular structure and enzymes involved ➢ Comment on the various sugar degradation pathways ➢ Describe with flow diagram , EMP,ED, TCA cycle and electron transport phosphorylation ➢ Describe anaerobic respiration with special reference to dissimilatory nitrate reduction
V			
VI			

B.SC MDC			
Semester	Course Code	Course Title	Outcome
I			

II			
III			
IV	UPOCMDC24050	Environmental Microbiology	**Course Objective:** This course has been designed as student-friendly by incorporating pressing issues related to global environmental context. The content in this course also reflect the importance of microorganisms in providing many essential services through its interaction with the biotic and abiotic components of the ecosystem. The importance of essential gaseous and non-gaseous elements required for survival of diverse group of organisms on earth and its cyclic transformation through dynamic biogeochemical cycling and the microbes involved shall be dealt extensively. It also provides an opportunity to appreciate the diversity of microorganism, abundance and microbial communities inhabiting a multitude of habitats and occupying a wide range of ecological habitats. The content of the course also stresses the urgent need of understanding the water as indispensable resource for the survival of human on this planet. The student will learn the various methods available for the determination of sanitary quality of water and sewage treatment methods employed in waste water treatment. **Learning Outcome:** ➢ Demonstrate an understanding of the principles of scientific inquiry. ➢ Demonstrate the ability to think critically and employ critical thinking skills. ➢ Demonstrate the ability to make connections between concepts across Microbiology. ➢ Describe how microbial metabolism can be manipulated for food production. ➢ Describe how food characteristics and the presence of microorganisms in food can lead to food spoilage. ➢ List several methods for preventing food spoilage. ➢ Discuss the basic types of illnesses caused by food spoilage or food contamination, and describe how they can be avoided. ➢ Describe the role of genetically manipulated microorganisms in industrial and agricultural processes and the basics of industrial- scale fermentation. ➢ List some of the various commercial products produced by microorganisms. ➢ Describe two waterborne illnesses. ➢ Explain how water for drinking and wastewater are treated to make them safe and usable. ➢ Define the terms used to describe microbial relationships within the environment.

			➢ Explain the influences of competition, antagonism, and cooperation on microbial survival. ➢ Describe the process of bioremediation. ➢ Contrast the processes by which microorganisms cycle carbon, nitrogen, sulfur and phosphorus. ➢ Explain the work of microorganisms in the carbon cycle. ➢ Elucidate the phosphorous pathway ➢ Contrast the actions of microbes involved in nitrogen fixation, nitrification, ammonification, denitrification, and anammox reactions. ➢ How microbes are used for degradation of pesticides ➢ Describe the importance of hydrocarbon degrading bacteria ➢ Describe the reduction and oxidation of sulfur by microbes. ➢ Identify five factors affecting microbial abundance in soils. ➢ Describe the various methods for solid waste management ➢ List the various methods available for waste water treatment ➢ Compare the characteristics and microbial populations of freshwater and marine ecosystems. ➢ Describe the MPN, P/A tests and membrane filter technique for assessing water quality ➢ State the strength of sewage with respect to BOD and COD parameters ➢ Compare and contrast symbiotic and non-symbiotic interactions