Department of Microbiology

Program Outcomes (POs)	
PO1	Demonstrate a comprehensive understanding of the principles and concepts in introduction to microbiology, basic techniques in microbiology, medical microbiology, immunology, genetics, enzymology, agricultural microbiology, marine microbiology, Food and dairy microbiology, metabolism, molecular biology, fermentation technology, waste management, air, water, and soil microbiology and nanobiotechnology.
PO2	Acquaint with the historical developments in microbiology and the contributions of key scientists to the field, propose appropriate cultivation strategies for specific microorganisms based on their nutritional requirements and growth conditions, evaluate the impact of microorganisms on human health, agriculture, biotechnology, and the environment, and solve problems related to microbial contamination, sterilization, disinfection and control in various steps.
PO3	Analyze the roles of microorganisms in environmental processes, such as nutrient cycling, decomposition, and bioremediation, microbial populations in air, water, and soil samples to assess their quality and potential ecological impacts identify and classify microorganisms associated with medical conditions and relevant chemotherapeutic a treatment, misuse of antibiotics, industrial processes, and environmental samples, design and implement experiments to study bacterial physiology, genetics, and fermentation processes.
PO4	Explain the epidemiology, transmission, and clinical manifestations of various infectious diseases, cellular and molecular mechanisms of innate and adaptive immunity, and transplantation, analyze the impact of agricultural practices on soil microbial communities and sustainability, describe the fundamental principles of genetics, including inheritance, gene expression, and genetic mutations, Analyze the potential applications of marine and dairy microbes in biotechnology and industry, the role of microorganisms in waste degradation and bioremediation, use of nanoparticles in drug delivery, diagnostics, vaccine production, wastewater treatment and environmental remediation
PO5	Apply laboratory techniques and methodologies learned in practical courses to effectively conduct experiments such as aseptic techniques, microbial culturing, microscopy, staining techniques medical microbiology, immunology, enzymology, genetics, fermentation technology, food and dairy, Nanotechnology, marine, agriculture and other relevant areas and interpret experimental data, making informed conclusions and recommendations.

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PO6	Develop Research skills, formulate research questions, design and conduct experiments, and analyse data to address scientific inquiries and apply critical thinking to solve problems in various fields of microbiology and draw conclusions based on scientific evidence.
PO7	Recognize the dynamic nature of microbiology and its ongoing advancements and effectively communicate scientific information through written reports, oral presentations, and visual aids, tailored to different audiences including peers, professionals, and the general public and Industrial visits.
PO8	Explore applications of microbiology in biotechnology, such as producing enzymes, biofuels, bioplastics, antibiotics, or other valuable compounds through microbial fermentation. Develop novel probiotics or prebiotics for gut health, immune support.

Program Specific Outcomes (PSOs)	
PSO-1	To accommodate more advanced topics in the syllabi, it is necessary to understand the basic science knowledge level of the students that have chosen the Microbiology discipline. Curricula of courses of state and central boards of higher secondary level were reviewed to avoid reiterations of previous syllabi.

FY - Program Specific Outcomes (PSOs)	
PSO-1	Students will be provided the basic information that includes – characteristics of microbial world. The microorganisms will be studied for morphological, structural characterization, isolations techniques from natural and extreme environments and their prominent features.
PSO-2	The methodology to develop keen observation i.e. different microscopy techniques, staining techniques and nutritional requirements will be taught in detail; including these aspects at laboratory level as well.
PSO-3	Introduction to biochemical characterization of components of micro-organism e.g. proteins, lipids, nucleic acids and carbohydrates and instrumental techniques to estimate these components qualitatively and quantitatively from micro-organisms or other natural sources will be the focus for second theory paper.
PSO-4	Relevant experimentation on these topics will be included in practical course. In practical course, students will be trained in preparing laboratory manuals, standard operating practices and logbooks

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SY - Program Specific Outcomes (PSOs)	
PSO-1	At second year under-graduation includes paper on principles of taxonomy and classification of major groups of microorganisms. The said paper will also include the physiological studies on these groups of microorganisms.
PSO-2	Second paper will deal with Air and Water Microbiology; role of micro-organisms in environment in regard to pollution and biodegradation; water and sewage treatment.
PSO-3	Practical for the second-year students will designed to be flexible incorporating project themes on environment, agriculture and pollution aspects to acquire laboratory skills.
PSO-4	Practical at this level will also include application of biostatistics principles, computers for data analysis, interpretation, introduction to scientific writing and report preparation. These aspects can be better while carrying out the mini projects.

TY - Program Specific Outcomes (PSOs)	
PSO-1	At third year under-graduation, The six theory papers will deal with broad areas of microbiology. Five such areas are – Medical microbiology, Microbial physiology, Microbial (prokaryotic and eukaryotic) genetics, Immunology and Fermentation technology.
PSO-2	The sixth course will be Applied Microbiology that will include – Dairy Microbiology, Food Microbiology, Fermentation Technology, Agriculture Biotechnology, Fungal Biotechnology, etc. The practical at third year will be planed more intensively, with exposure to applied fields and hands-on training

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Sanjivani Rural Education Society's
SANJIVANI ARTS, COMMERCE AND SCIENCE COLLEGE
At: Sahajanandnagar, Post: Shingnapur, Tal: Kopargaon,
Dist: Ahmednagar (M.S.) Pin:423603
Recognized by Govt. of Maharashtra, Affiliated to University of Pune, ID.No.PU/AN/ACS/130/2012

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Course Outcome: Bsc (Microbiology subjects)

Class	Course Title	Course Outcome
FY BSc Paper I	**DSEC- MB 111: Introduction to Microbial World**	CO1:Understand history of microbiology CO2:Acquire knowledge of different Eras of Microbiology and become acquainted with Nobel laureates in Life Sciences of 21st Century CO3:Gain knowledge about different types of Microorganism with their differentiating characters CO4:Understand beneficial and harmful effects of microorganisms in different fields of Microbiology
FYBSc Paper II	**DSEC- MB 112: Basic Techniques in Microbiology**	CO1:Get knowledge of Modern SI units CO2:Understand Principles and Working of different types of Microscopes CO3:Gain knowledge of different types of staining techniques and role of fixatives, mordants, decolourisers and accentuators in staining CO4:Understand the concept of sterilization and disinfection
FYBSc Paper III	**DSEC-MB – 113: F. Y. B. Sc. Microbiology Practical Course**	CO1:Describe the good lab practices and biosafety measures to be adopted while working in a microbiology lab and identify diferent instrument commonly used for microbiological experiments. CO2:Give example of different nutrient media popularly used in culturing microorganisms and campae different methods of sterilizing them. CO3:Explain morphological characteristics of different microbial life forms by microscopic observation.

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FYBSc Paper I	**DSEC- MB 121: Bacterial Cell and Biochemistry**	CO1:Understand structure, chemical composition and functions of the components in bacterial cell CO2:Comprehend chemical basis of Microbiology CO3:Learn structure, organization and functions of carbohydrates, lipids, proteins & nucleic acids CO4:Be familiar with classification of bacteria (Bergey's Manual and Systemic Bacteriology) and Viruses (ICTV Nomenclature)
FYBSc Paper II	**DSEC- MB 122: Microbial Cultivation and Growth**	CO1:Gain knowledge of cultivation of microorganisms: Nutritional classification, Design and Preparation of media CO2:Comprehend isolation and maintenance of bacteria, algae, fungi, actinomycetes and viruses CO3:Understand the Role of National Biodiversity Authority for culture collection centres CO4:Become acquainted with Bacterial growth kinetics, Growth curve, Generation time and Diauxic growth CO5:Learn different methods of enumeration of bacterial growth with factors affecting bacterial growth.
FYBSc PaperIII	**DSEC-MB – 123: F. Y. B. Sc. Microbiology Practical Course**	CO1:Understand concept of microorganism with respect to its size, shape, occurrence and types. CO2:Differentiate between different types of microorganisms CO3:Understand principal and use of compound microscope and staining techniques to observe microorganisms CO4:Understand types of useful and harmful microorganisms
SYBSc Paper I	**MB-231: Medical Microbiology and Immunology**	CO1:Understanding the concept of epidemiology with respect to terms like Incubation period, Viability, Susceptibility, Pathogenicity, Virulence, Pathogenesis, Lab diagnosis, Epidemic, Sporadic, Endemic and Pandemic. CO2: Acquainted with human pathogens such as *Escherichia coli*,

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		Staphylococcus aureus and Fungi like Yeast- *Candida* as well as Dermatophytes. CO3: Principles of Chemotherapy are introduced based on Selective toxicity, Bioavailability, MIC, MBC, LD50. Accustomed with the terms Antagonism and synergism in drug administration., Antibiotic sensitivity, Antibiotic misuse/antibiotic overuse and Concept of drug resistance (e.g., MRSA, ESBL) CO4:Comprehend the term immunity with its types get knowledge of haematopoiesis, Antigens and antibodies, Immunohematology, Inheritance of ABH antigens, Medico legal applications of blood groups CO5:Acquainted with Active and Passive immunization
SYBSc Paper II	**MB-232: Bacterial Physiology and Fermentation Technology**	CO1:Acquainted with the term Enzymes, its nomenclature and classification and models for catalysis CO2:Understand the effect of pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors on enzymes CO3:Understanding the concept of Bacterial Physiology with reference to metabolism, catabolism, anabolism, respiration and fermentation CO4:Comprehend the different metabolic pathways with structures CO5:Acquainted with design of a fermenter, fermentation parameters, use of media for industrial fermentations CO6:Understand the sources of contamination during fermentations
SY BSc	**MB-241: Bacterial**	CO1:Understanding the different experimental evidence for

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Paper I	**Genetics**	nucleic acid as genetic material CO2:Comprehend the different types of nucleic acids, Structure of DNA and Prokaryotic DNA replication. CO3:Understand the different models and modes of DNA replication with its basic rules of DNA replication CO4:Get knowledge of Gene expressions, Mutations and reversions CO5:Acquainted with Plasmid genetics
SYBSc Paper II	**MB-242: Air, Water and Soil Microbiology**	CO1:The course will help them to get knowledge of the Air Microbiology, methods of air sampling, different types of air samplers, air sanitation and airborne infections. CO2:Deals with water microbiology including bacteriological analysis of water, methods of water purification, water borne infections and bacteriological standards of water quality. CO3:Understand Soil Microbiology, rhizosphere, composting and humus formation, biofertilizers, biocontrol agents and microbial interactions. CO4:Acquire knowledge of carbon and nitrogen cycles with role of microorganisms
TYBSc Paper I	**DSEC-MB 351: Medical Microbiology- I And DSEC-MB 361: Medical Microbiology II**	CO1:Understand the human anatomy, pathogens associated with diseases. CO2:Acquire knowledge of principles underlying establishment of pathogens in human body. CO3:Comprehend of pathogenesis of specific pathogens causing microbial diseases. CO4:Assess epidemiological patterns of microbial disease transmission as various modes, intensity at local and global level. CO5:Gain Knowledge principles of chemotherapy of microbial

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		diseases and development of drug resistance among pathogens and strategies to mitigate. CO6:Develop identification systems for microbial disease diagnosis, disease treatment and prevention measures
TYBSc Paper II	**DSEC-MB-352 Immunology- I and**	CO1:Understand immune system structure, composition, function and comparison of different types of immunity. CO2:Acquire knowledge about antigens, Recognition of pathogens; antigen processing and presentation; Immunity to infection and pathological consequences of immunod efficiencies. CO3:To learn the applications of Immunology in monoclonal antibodies, vaccines production and Immunotherapy. CO4:Understand abnormal working of Immune system in hypersensitivity, auto immune diseases, immune tolerance and transplantation immunology. CO5:To develop strategies for Diagnosis of diseases based on antigen and antibody reactions with emphasis on prevailing communicable diseases.
TYBSc Paper III	**DSEC-MB 353: Enzymology And DSEC-MB 363: Metabolism**	CO1:To understand methods of active site determination, role of enzymes and its cofactors in microbial physiology. CO2:To learn to perform enzyme assay, purification and quantification of enzymes activity, enzyme kinetics in terms of initial, final velocity, mathematical expression of enzyme kinetic parameters. CO3:To correlate regulation of metabolism at enzymatic levels and apply, methodology for commercial applications of enzymes CO4:To learn mechanisms of transport of solutes across the membrane CO5:To get acquainted with mechanism of biosynthesis and

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		degradation of biomolecules CO6To comprehend basic concept of autotrophic mode of metabolism of prokaryotes
TYBSc Paper IV	**DSEC -MB 354: Genetics and DSEC -MB-364: Molecular Biology**	CO1:To exhibit a knowledge base in Genetics and Molecular Biology CO2:To understand the central dogma of Molecular Biology CO3:To construct genetic map of bacteria and fungi CO4:To get introduced to concept of recombination and bacteriophage Genetics CO5:To understand the concept cloning in bacteria CO6:To demonstrate the knowledge of common and advanced laboratory practices in Molecular Biology
TYBSc Paper V	**DSEC -MB 355 Fermentation Technology I and DSEC - MB 365 Fermentation Technology – II**	CO1:To impart technical understanding of commercial fermentations. CO2:To apply classical, advanced strain improvement and isolation techniques for fermentation processes. CO3:To optimize and sterilize media used in fermentation industry for commercially economical and efficient fermentations. CO4:To recover the product using suitable methods and ensuring quality of the finished product by quality assurance tests. CO5:To acquaint fermentation economics, process patentability, process validation. CO6:To comprehend the large-scale productions of commercially significant fermentation products of classical and recent significance

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TYBSc Paper VI	**DSEC - MB 356: Agricultural Microbiology**	CO1:To understand plant growth improvement with respect to disease resistance, environment tolerance. CO2:To correlate stages of plant disease development, epidemiology, symptom based classification, control methods. CO3:To understand the importance of microorganisms in sustainable agriculture, biotechnological application of bio films, edible vaccines. CO4:To correlate Soil Micro biome and Role of microorganisms in soil health CO5:To determine the use of Microorganisms as tools in plant genetic engineering.
TYBSC Paper VII	**Skilled Base Elective MB 3510 Marine Microbiology**	CO1:To impart the awareness of unseen and unexplored niche of marine ecosystem of microbes. CO2:To acquire advances in the knowledge of marine microbes and marine ecology. CO3:To learn the field research on marine processes and laboratory research on microorganisms. CO4:To comprehend the role of marine microbes in bioremediation and bioprospecting. CO5:To avail career opportunities in marine education, industry and research.
TYBSc Paper VIII	**Skilled Base Elective MB 3511 Dairy Microbiology**	CO1:To understand prospects of dairying at commercial marketing. CO2:To acquire skills of processing of milk and dairy products. CO3:To assess quality control in dairy industry. CO4:To comprehend production of dairy products of commercial significance with emphasis tolocal and global market demand.

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TY BSc Sem II	**DSEC - MB 366: Food Microbiology**	CO1:To describe food safety problems and solutions in India and global scale. CO2: Identify and classify types of microorganisms in food processing and compare their Characteristics and behaviour CO3:To learn food classification based on their perishability, intrinsic and extrinsic factors affecting the growth of microbes in foods, role of microorganisms in food fermentation. CO4: To acquire knowledge about food spoilage, food borne diseases, predisposition and preventive and control measures. CO5: To apply principles of sanitation, heat treatment, irradiation, modified atmosphere, antimicrobial preservatives and combination of method (hurdle concept) to control microbial growth with emphasis on HACCP guidelines.
TY BSc Sem II	**Semester VI Skilled Base Elective MB 3610 Waste Management**	CO1:To understand waste management and it practicable applicability. CO2:To assess the magnitude and influence of hazardous content of waste, pollution of waters and waste water treatment technologies. CO3:To learn the design and working of treatment plants and methods used for liquid and solid waste treatment. CO4:To impart the understanding of kineticf biological systems used in waste treatment. CO5: To learn the standards of waste management and competent authorities involved at National and international level.
TY BSc Sem II	**Skilled Base Elective MB 3611 Nano-biotechnology**	CO1:To understand design, development and application of Nanomaterials and their application in Nanodevices. CO2:To learn fundamentals of nanotechnology as to Synthesis and characterization techniques of nanoparticles.

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		CO3: To acquire knowledge of applications of nanomaterials in different disciplines of human life. CO4: To compare the merits of using nanotechnology with existing technologies.
TYBSc Practical I	**DSEC-MB – 357: Diagnostic Microbiology and Immunology**	CO1:Gain hands on experience of hematology, immunotechniques. CO2:Illustrate the data obtained from biochemical analyzes of sample such as whole blood, serum, urine etc. With clinical symptoms and possible pathologies.
TYBSc Practical II	**Enzymology and Genetics**	CO1:Understand to handle microorganisms for isolation and amplication of DNA and transform host cells CO2:Understands principles and application of various chromatographic techniques, UV- spectroscopy
TYBSc Practical III	**Agriculture microbiology and Fermentation technology**	CO1:Understands MIC and MBC principal and how to perform CO2:Analyze the potency of antibiotics using bioassay technique. CO3:To Identify various diseases of plants.

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