

# Kalinga University

## Science

### Master of Science (Microbiology)

#### PO

| S. No. | Program Outcome (PO) Description                                                                                                                                                                                                                     |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Advanced Microbial Taxonomy and Diversity: Students will demonstrate an in-depth understanding of the taxonomy, classification, and diversity of microorganisms, including bacteria, archaea, viruses, fungi, and protozoa.                          |
| 2      | Ethical Conduct and Responsible Research: Students will demonstrate a commitment to ethical principles and responsible conduct in scientific research, including issues related to data management, authorship, and potential conflicts of interest. |
| 3      | Interdisciplinary Collaboration: Students will develop the ability to collaborate effectively with experts from different disciplines to address complex scientific challenges and contribute to multidisciplinary research projects.                |
| 4      | Leadership and Management Skills: Students will acquire leadership and management skills, enabling them to lead research teams, manage projects, and foster a culture of innovation in microbiology-related organizations and industries.            |
| 5      | Cutting-Edge Microbiological Techniques: Students will gain advanced proficiency in state-of-the-art laboratory techniques used in modern microbiological research, including genomics, proteomics, bioinformatics, and advanced imaging methods.    |
| 6      | Systems Microbiology: Students will be able to analyze and comprehend complex microbial interactions within ecosystems and host-microbe interactions at a systems level, including the study of microbiomes.                                         |
| 7      | Microbial Pathogenesis and Immunology: Students will acquire detailed knowledge of the molecular mechanisms of microbial pathogenesis, host immune responses, and the development of novel approaches for disease treatment and prevention.          |

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| 8  | Applied Biotechnology and Industrial Microbiology: Students will be capable of applying advanced microbiological principles in biotechnological processes, pharmaceutical development, and industrial applications, including biofuel production and bioremediation. |
| 9  | Advanced Medical Microbiology: Students will be equipped to analyze and diagnose infectious diseases, interpret antimicrobial resistance patterns, and explore emerging infectious agents, preparing them for roles in clinical microbiology and public health.      |
| 10 | Environmental Microbiology and Bioremediation: Students will understand the roles of microorganisms in environmental processes, biogeochemical cycling, and the use of microbial-based technologies for environmental remediation.                                   |
| 11 | Research Design and Implementation: Students will develop strong research skills, including the ability to design experiments, analyze data, and critically evaluate scientific literature, fostering their potential as independent researchers.                    |
| 12 | Scientific Communication and Publication: Students will effectively communicate research findings through scientific writing, oral presentations, and poster sessions, preparing them to disseminate knowledge within the scientific community.                      |

## PSO

| S. No. | Program Specific Outcome (PSO) Description                                                                                                                                                            |
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| 1      | Endeavors to instill in students the skills to identify individual microbial species, use aseptic techniques to grow them in pure culture, safely handle and examine them by microbiological methods. |
| 2      | The knowledge of microbiology will enable the students to improve the quality of human lives in relation to environment, fighting disease and to exploit microbes in the production of food.          |
| 3      | Will gain and apply knowledge to solve problems related to field of Microbiology.                                                                                                                     |
| 4      | Will be able to design and develop solution to problems by applying appropriate tools and microbes while keeping in mind safety factor for environment and society.                                   |

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| 5 | Will be able design, perform experiments, analyze and interpret data for investigating complex problems in applied science and related fields.                                                                                                                           |
| 6 | Will be able to undertake any responsibility as an individual and as a team in a multidisciplinary environment.                                                                                                                                                          |
| 7 | Acknowledges health, safety and environment (HSE) issues in handling chemicals and biological materials; understands the environmental impacts associated with the activity; performs risk assessments and is familiar with safety instructions in his/her subject area. |
| 8 | Can 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                                                                             |



# KALINGA UNIVERSITY

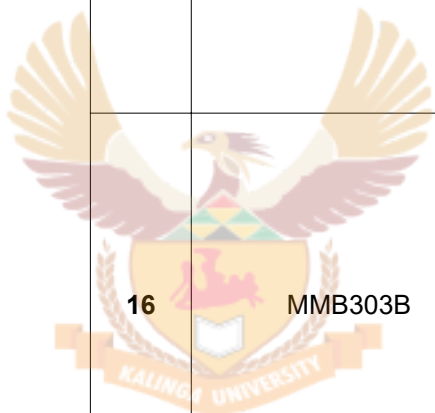
# CO

| S.No. | Course Code | Course Name                    | Course Outcome (CO's) - Description                                                                                                                                                     |
|-------|-------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | MMB101      | Principles of Microbiology     | <b>CO1:</b> Student will know the history and morphological features of bacteria.                                                                                                       |
|       |             |                                | <b>CO2:</b> Student will be able to general characteristics of bacteria and archaea and specific key features of model archaeal organisms.                                              |
|       |             |                                | <b>CO3:</b> Understanding of basic microbial structure and similarities and differences among various groups of microorganisms such as bacteria/archaea/cyanobacteria/fungi/protozoans  |
|       |             |                                | <b>CO4:</b> Students will be able to understand Scope of Microbiology                                                                                                                   |
|       |             |                                | <b>CO5:</b> Know about bacterial diseases.                                                                                                                                              |
| 2     | MMB102      | Principles of Biochemistry     | <b>CO1:</b> Understanding of the fundamentals Biochemistry and key principles of Biochemistry.                                                                                          |
|       |             |                                | <b>CO2:</b> classification, structure, function, significance and biosynthesis and the degradation pathways of the above mentioned biomolecules                                         |
|       |             |                                | <b>CO3:</b> Conceptual knowledge of properties, structure, function of enzymes, enzyme kinetics and their regulation ,enzyme engineering,                                               |
|       |             |                                | <b>CO4:</b> Application of enzymes in large scale industrial processes.                                                                                                                 |
|       |             |                                | <b>CO5:</b> Concepts of lipid and nitrogen metabolism, oxidation of fatty acid, assimilation of nitrates, ammonia assimilation.                                                         |
| 3     | MMB103      | Bacteriology & Virology        | <b>CO1:</b> Know about bacterial Classifications                                                                                                                                        |
|       |             |                                | <b>CO2:</b> Understanding of basic microbial structure and similarities and differences among various groups of microorganisms such as bacteria/archaea/cyanobacteria/fungi/protozoans. |
|       |             |                                | <b>CO3:</b> Acquaintance on study of microbial diversity using different methods and systematics of bacteria and archaea using polyphasic approach.                                     |
|       |             |                                | <b>CO4:</b> Understand the Morphology; metabolism; ecological significance and economic importance of gram negative bacterial group                                                     |
|       |             |                                | <b>CO5:</b> Understand the Morphology; metabolism; ecological significance and economic importance of gram positive bacterial group.                                                    |
| 4     | MMB104      | Applied Mycology and Phycology | <b>CO1:</b> Understand about the Introduction of algae and Fungi.                                                                                                                       |
|       |             |                                | <b>CO2:</b> Know about the life cycle of representative genera.                                                                                                                         |
|       |             |                                | <b>CO3:</b> Students will be able to understand the importance of algae.                                                                                                                |
|       |             |                                | <b>CO4:</b> Students will be able to understand the role of fungi.                                                                                                                      |
|       |             |                                | <b>CO5:</b> Know about the importance of fungi in food,medicine and industry                                                                                                            |
|       |             |                                | <b>CO1:</b> Students will understand a general definition of research design.                                                                                                           |

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| 5 | MMB105A | Research Methodology                | <b>CO2:</b> Students will know why educational research is undertaken, and the audiences that profit from research studies.                                                                                                                                                                                                                                                                                                                                                              |
|   |         |                                     | <b>CO3:</b> Students will be able to identify the overall process of designing a research study from its inception to its report.                                                                                                                                                                                                                                                                                                                                                        |
|   |         |                                     | <b>CO4:</b> Students will be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research                                                                                                                                                                                                                                                                                                                      |
| 6 | MMB105B | Science Journalism                  | <b>CO1:</b> They will appreciate the digital landscape within which science journalism exists today by learning: blogging in science journalism (honing your craft, developing a voice); how to get work (pitching and staying relevant); the value of social networks for science journalism (sharing stories, finding stories, joining discussions and finding sources); digital strategies employed by major news organizations (data visualization, multimedia, community building). |
|   |         |                                     | <b>CO2:</b> Students will analyze and learn about the structure of several types of data including numbers, texts and documents. Students will learn the skills to examine, evaluate, and critique those data, extract patterns, summarize features, create visualizations, and provide insights, while learning to be sensitive to ethical concerns associated                                                                                                                          |
| 7 | MMB201  | Microbial Physiology and Metabolism | <b>CO1:</b> Acquaint with basics of metabolism and growth under normal and stressed conditions.                                                                                                                                                                                                                                                                                                                                                                                          |
|   |         |                                     | <b>CO2:</b> Get well versed with various life process like photosynthesis, respiration and fermentation, anaerobic respiration, and bacterial sporulation                                                                                                                                                                                                                                                                                                                                |
|   |         |                                     | <b>CO3:</b> Elucidate bacterial membrane transport                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|   |         |                                     | <b>CO4:</b> Understand major fermentation, aerobic and anaerobic pathways for energy generation in microbial cells.                                                                                                                                                                                                                                                                                                                                                                      |
|   |         |                                     | <b>CO5:</b> Discuss the concept of nitrogen metabolism                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8 | MMB202  | Medical Microbiology                | <b>CO1:</b> Understanding of the fundamentals of Medical Microbiology and key principles of it.                                                                                                                                                                                                                                                                                                                                                                                          |
|   |         |                                     | <b>CO2:</b> Upon completion, students gained the knowledge of most common medically important organism and the infections they cause.                                                                                                                                                                                                                                                                                                                                                    |
|   |         |                                     | <b>CO3:</b> Different approaches, techniques and tools used to identify pathogens and control them.                                                                                                                                                                                                                                                                                                                                                                                      |
|   |         |                                     | <b>CO4:</b> Diagnostic approaches for microbial pathogens                                                                                                                                                                                                                                                                                                                                                                                                                                |
|   |         |                                     | <b>CO5:</b> Know about important bacterial and viral disease.                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |         |                                     | <b>CO1:</b> Can discuss the importance of mutation analysis, can analyze mutations by complementation and recombination tests, and can design a strategy to create gene replacement in bacteria                                                                                                                                                                                                                                                                                          |
|   |         |                                     | <b>CO2:</b> Is able to explain how plasmid copy number is regulated, can differentiate between Hfr strains and strains carrying F plasmid, and can construct a genetic map of bacterial genome using conjugation-based method                                                                                                                                                                                                                                                            |

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| 9  | MMB203  | Microbial Genetics                    | <p><b>CO3:</b> Is able to compare and contrast generalized versus specialized transduction, knows how to construct genetic linkage maps using two-factor and three factor cross, is able to discuss the basis of natural competence in bacteria.</p> <p><b>CO4:</b> Is able to list the events in the lytic and lysogenic phases of lambda phage life cycle and the regulatory factors and events involved.</p> <p><b>CO5:</b> Can differentiate between positive and negative regulation of gene expression, inducible and repressible systems. Can describe the regulation of the lac, trp, gal, ara and tol operons.</p>                                   |
| 10 | MMB204  | Biotechnology and Genetic Engineering | <p><b>CO1:</b> The students are be able to understand in-depth knowledge on the history and concepts and scope in bio-technology</p> <p><b>CO2:</b> The students are be able to gain knowledge on biotransformation &amp; production of useful compounds and uses of biosensors.</p> <p><b>CO3:</b> The students are able to know the alternate energy sources and generation of energy from biomass energy</p> <p><b>CO4:</b> The students are be able to understand the concepts and methods in genetic Engineering</p> <p><b>CO5:</b> The students are be able to acquire knowledge on applications of genetic engineering</p>                             |
| 11 | MMB205A | Entrepreneurship                      | <p><b>CO1:</b> Develop awareness about entrepreneurship and successful entrepreneurs.</p> <p><b>CO2:</b> Develop an entrepreneurial mind-set by learning key skills such as design, personal selling, and communication.</p> <p><b>CO3:</b> Understand the DNA of an entrepreneur and assess their strengths and weaknesses from an entrepreneurial perspective.</p>                                                                                                                                                                                                                                                                                          |
| 12 | MMB205B | Intellectual Property Rights          | <p><b>CO1:</b> The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.</p> <p><b>CO2:</b> This course provide further way for developing their idea or innovations.</p> <p><b>CO3:</b> To Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&amp;D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur</p> |
| 13 | MMB301  | Immunology                            | <p><b>CO1:</b> Demonstrate an understanding of key concepts in immunology.</p> <p><b>CO2:</b> Understand the overall organization of the immune system .</p> <p><b>CO3:</b> Learn about immunization and their preparation and its importance.</p> <p><b>CO4:</b> Begin to appreciate the significance of maintaining a state of immune tolerance sufficient to prevent the emergence of autoimmunity.</p> <p><b>CO5:</b> To make them understand the salient features of antigen antibody reaction &amp; its uses in diagnostics and various other studies</p>                                                                                               |

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| 14 | MMB302  | Molecular Microbiology                 | <b>CO1:</b> Understand the principles and concepts of molecular microbiology.                                                                                                             |
|    |         |                                        | <b>CO2:</b> Gain knowledge of the structure and function of microbial cells and their components.                                                                                         |
|    |         |                                        | <b>CO3:</b> Learn about the techniques and tools used in molecular microbiology research.                                                                                                 |
|    |         |                                        | <b>CO4:</b> Develop skills in molecular biology techniques, such as DNA extraction, PCR, and gene cloning.                                                                                |
| 16 | MMB303A | Industrial Microbiology                | <b>CO1:</b> Understand the role of molecular techniques in studying microbial diversity and evolution.                                                                                    |
|    |         |                                        | <b>CO2:</b> Understanding of industrial production and purification of organic acids, alcohols, wine and vinegar with help of different microbes.                                         |
|    |         |                                        | <b>CO3:</b> Understanding of industrial production and purification of antibiotics, enzymes, amino acids and Ø steroids.                                                                  |
|    |         |                                        | <b>CO4:</b> Understanding of different pathways followed in or by the microbes involved in production of these bio-chemicals. Method of manipulating these pathways to get desired yield. |
|    |         |                                        | <b>CO5:</b> Understanding of application of these bio-molecules in benefit of mankind.                                                                                                    |
| 16 | MMB303B | Food Microbiology                      | <b>CO1:</b> Understand the principles of microorganisms during various food-processing and preservation steps.                                                                            |
|    |         |                                        | <b>CO2:</b> Comprehend the interactions between microorganisms and the food environment, and factors Ø influencing their growth and survival.                                             |
|    |         |                                        | <b>CO3:</b> Understand the significance and activities of microorganisms in food.                                                                                                         |
|    |         |                                        | <b>CO4:</b> Recognize the characteristics of food-borne, waterborne and spoilage microorganisms, and Ø methods for their isolation, detection and identification.                         |
|    |         |                                        | <b>CO5:</b> Analyze the importance of microbiological quality control programme's in food production. Discuss the microbiology of different types of food commodities.                    |
|    |         |                                        | <b>CO6:</b> Describe the rationale for the use of standard methods and procedures for the microbiological analysis of food.                                                               |
| 17 | MMB304A | Biochemical and Biophysical Techniques | <b>CO1:</b> Be familiar with the output of fluorescence and confocal microscopy .                                                                                                         |
|    |         |                                        | <b>CO2:</b> Be able to carry out the analysis of the data from CD and Fluorescence experiments to monitor the stability of the protein under different environmental conditions           |
|    |         |                                        | <b>CO3:</b> Be able to design a multi-step purification protocol for a target protein.                                                                                                    |
|    |         |                                        | <b>CO4:</b> Be able to perform chromatographic methods of separation.                                                                                                                     |
|    |         |                                        | <b>CO5:</b> Be able to understand and correctly interpret the migration of protein molecule on PAGE under native and SDS conditions                                                       |
|    |         |                                        | <b>CO1:</b> Understand the principles and concepts of molecular microbiology.                                                                                                             |
|    |         |                                        | <b>CO2:</b> Gain knowledge of the structure and function of microbial cells and their components.                                                                                         |
|    |         |                                        | <b>CO3:</b> Learn about the techniques and tools used in molecular microbiology research.                                                                                                 |



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| 18 | MMB304B | Downstream processing             | <b>CO4:</b> Develop skills in molecular biology techniques, such as DNA extraction, PCR, and gene cloning.<br><b>CO5:</b> Understand the role of molecular techniques in studying microbial diversity and evolution.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 19 | MMB401  | MICROBIAL PATHOGENICITY           | <b>CO1:</b> To understand classical and molecular determinants of disease-causing microbes.<br><b>CO2:</b> To describe the characteristics of newer disease-causing bacteria and viruses.<br><b>CO3:</b> To study and critique the various molecular tools available to work on the molecular epidemiology of disease-causing microorganisms.<br><b>CO4:</b> To study and evaluate mechanisms underlying resistance of bacteria to antibiotics, spread of resistance and the use of newer vaccines to control infectious diseases.<br><b>CO5:</b> To gather information as to how the infectious diseases may be diagnosed using newer diagnostic tools and what automated equipment are available for use in diagnostic microbiology laboratories. |
| 20 | MMB402A | Environmental Microbiology        | <b>CO1:</b> Understand on soil characteristics and biogeochemical cycling<br><b>CO2:</b> Know the microbial analysis of drinking water and aeromicrobiology<br><b>CO3:</b> Know on the different aspects of waste management and sewage Treatment systems<br><b>CO4:</b> Acquire knowledge on bioremediation and microbial leaching<br><b>CO5:</b> Know the biosafety and environmental monitoring regulations                                                                                                                                                                                                                                                                                                                                      |
| 21 | MMB402B | Agriculture and Soil Microbiology | <b>CO1:</b> Understand the role of microbes in the different cycles and their role in agriculture<br><b>CO2:</b> Understand biological nitrogen fixation in symbiotic and non symbiotic associations with plants.<br><b>CO3:</b> To know the value, production, application and crop response of biofertilizers and biopesticides.<br><b>CO4:</b> To have an indepth knowledge on biopesticides and their role in pest control.<br><b>CO5:</b> To know about plant pathogenic microorganism                                                                                                                                                                                                                                                         |