Deccan Education Society's

Fergusson College (Autonomous), Pune

Program Specific Outcomes(PSOs) and Course Outcomes (COs) 2019-20

Department of Microbiology

Programme: M.Sc. Microbiology

PSO No.	Program Specific Outcomes(PSOs) **Upon completion of this programme the student will be able to**
PSO1	**Academic competence:** i) Describe microbial processes that can be used for the development of biochemical and immunological tools to improve the quality of human life. ii) Study the cytology, biochemistry, growth as well as application of environmentally and industrially important microbes with a specific emphasis on improving environmental sustainability and human health. iii) Describe and understand the concepts of the role of microorganisms in geochemical processes like leaching of metals and bioremediation methods.
PSO2	**Personal and Professional competence:** i) Apply tools of molecular taxonomy and bioinformatics to the study of diverse microbial groups. ii) Evaluate industrially important microbial products in terms of their purity, safety and ethically acceptable application for the benefit of mankind. iii) Combine public presentation skills of effective articulation and nonverbal communication with a sound understanding of microbial science to effectively communicate ideas.
PSO3	**Research competence:** i)Validate scientific hypothesis and editorialize experimental scientific data by using statistical tools applicable to biological sciences. ii) Integrate principles of biology and physical sciences to standardize detection and quantification methods using sophisticated techniques.
PSO4	**Entrepreneurial and Social Competence:** i) Employ skill sets related to Quality assurance and testing of pharmaceutically important products in accordance with internationally accepted standards. ii) Evaluate the importance of new groups of consumer goods such as prebiotics, probiotics and nutraceuticals. iii) Apply the concepts of microbial interactions in basic and advanced treatment of waste water treatment processes.

Course Outcomes (COs)		
F.Y. M.Sc. Semester I		
Title of the Course and Course Code	**Microbial Diversity and Molecular Taxonomy (MIC4101)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List the various methods used for sequencing the genomes of micro-organisms and state the reasons for their entry into the unculturable state.	1
CO2	Differentiate between Bergey's manuals of Determinative and Systematic Bacteriology. Explain the mechanisms used by extremophiles to survive under extreme conditions.	2
CO3	Apply the knowledge of extremophiles and predict their presence in different unexplored environments.	3
CO4	Relate the unculturable microbial diversity to different problems such as disease outbreaks.	4
CO5	Evaluate the microbial diversity of a habitat using culture dependent as well as the metagenomic approach.	5
CO6	Construct a hypothetical phylogenetic tree based on the given characteristics of microorganisms.	6
Title of the Course and Course Code	**Biochemistry (MIC4102)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall and use fundamental thermodynamic laws and equations applicable to biological systems	1
CO2	Compare the types of noncovalent chemical bonds important in the stability of biomolecules in terms of their prevalence, strength and focus on their importance in biological processes.	2
CO3	Apply the knowledge to represent the data obtained from inhibition of enzymes graphically to predict the nature of the inhibitor and its significance. Calculate the thermodynamic transactions occurring in biological systems.	3
CO4	Categorize the use of biomolecules as buffering agents based on their dissociation properties and isoelectric pH values.	4
CO5	Evaluate the use of molecular transducers and transport proteins in biological systems based on their energy requirements, prevalence and relate the constitutive use of these mechanisms with their biological functions.	5
CO6	Specify important allosteric enzymes from biochemical pathways and propose their importance as key regulators of metabolism in biological systems.	6

Title of the Course and Course Code	**Molecular Biophysics and Instrumentation (MIC4103)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the theoretical aspects of UV-Visible, IR, NMR, XRD and mass spectroscopy.	1
CO2	Articulate and differentiate working principles, instrumentation and applications of various techniques used to analyze properties and structures of biomolecules.	4
CO3	Outline the importance of different biophysical techniques in microbiology.	5
CO4	Analyse the structure of biomolecules using XRD and NMR.	2,3
CO5	Review and characterize metal and magnetic nanoparticles using microorganisms.	6
CO6	Plan and propose the techniques and underlying theory of UV-Visible, IR, NMR, XRD and mass spectroscopy used to study biomolecules.	2
Title of the Course and Course Code	**Isolation and Identification of Microorganisms (MIC4104)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Tell the different methods, culture media and culture conditions used for the cultivation of different microorganisms.	1
CO2	Classify the microorganisms into different categories based on their characteristics.	2
CO3	Examine the culture conditions or media to obtain the expected results.	3
CO4	Analyze the results of the different conducted experiments and relate them.	4
CO5	Evaluate the microbial diversity of a habitat using culture dependent methods.	5
CO6	Formulate culture media for the cultivation of microorganisms. Construct a hypothetical phylogenetic tree based on the given characteristics of microorganisms using MEGA and PHYLIP software.	6
Title of the Course and Course Code	**Practicals Based on Biochemistry, Molecular Biophysics, Applied Microbiology, Cell and Developmental Biology (MIC4105)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive**

		level
CO1	Outline Good Laboratory Practices (GLPs) and laboratory safety with day to day working in microbiology laboratory.	1
CO2	Describe protocols to prepare buffers of biological importance.	6
CO3	Construct enzyme purification methods from biological sources like bacteria and fungi and determine ion exchange capacity of resins.	4
CO4	Analyze kinetic parameters of enzyme action on its substrate by carrying out appropriate experiments and evaluate the allowed conformation of proteins using Ramachandran plot.	5
CO5	Test the ecological potential of microorganisms such as degradation of recalcitrant compounds and evaluate various parameters of compost samples. Choose experiments to isolate bacterial pigments and to assess biofilm formation by bacteria.	2
CO6	Design experiments for the degradation of natural wastewater and artificial wastewater by microorganisms. Infer different stages of mitosis and stages of development in Drosophila embryos.	3
Title of the Course and Course Code	**Applied Microbiology (MIC4106D)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the role of microorganisms in biofilm formation which is responsible for destruction of metallic and wooden articles in different fields.	1
CO2	Explain different extraction methods for precious metals that are employed in various countries.	2
CO3	Outline biochemical pathways involved in bioremediation of recalcitrant xenobiotic compounds.	4
CO4	Explain different wastewater treatment methods.	3
CO5	Appraise the advanced waste water treatment processes for treating industrial wastes containing toxic chemicals.	5
CO6	Write a report on the general principles of wastewater treatment processes.	6
Title of the Course and Course Code	**Cell and Developmental Biology (MIC4107G)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe various events in the cell cycle.	1
CO2	Explain diagrammatically the ultrastructure of eukaryotic cells. Outline the cellular signalling mechanisms in higher organisms at the molecular level.	2
CO3	Illustrate the effect of fundamental activities such as homeostasis and morphogen gradients on the process of cellular development.	3
CO4	Explain diagrammatically trafficking of biomolecules in the	4

	compartments of eukaryotic cells.	
CO5	Compare vertebrate and invertebrate developmental systems.	5
CO6	Write the application of advanced microscopic techniques for localization of macromolecules in eukaryotic cells.	6
	F.Y. M.Sc. Semester II	
Title of the Course and Course Code	**Microbial Metabolism (MIC4201)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall key steps in the biological fixation and assimilation of nitrogen along with the biocatalytic agents involved and focus on the regulation of nitrogen turnover in microbial communities.	1
CO2	Discuss the composition of electron transport chains present in various biological systems with energy conservation in the form of high energy compounds and compare their efficiency.	2
CO3	Compute the energy output for a variety of respiratory and fermentative pathways in microbial systems and explain their ecological significance.	3
CO4	Categorize inhibitors and uncouplers of phosphorylation in biological energy conservation mechanisms.	4
CO5	Compare the photosynthetic potential and evolution of photosynthetic bacteria with higher photosynthetic systems.	5
CO6	Write the interactions between proteins and nucleic acids and justify the importance of these interactions in biological systems.	6
Title of the Course and Course Code	**Immunology (MIC4202)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe different cell surface molecules, receptors and label different proteins involved in signal transduction pathways.	1
CO2	Represent T and B cell receptors, G protein coupled receptors diagrammatically.	2
CO3	Classify different methods for regulation of immune response.	3
CO4	Analyze different methods for regulation of the complement system.	4
CO5	Review different escape mechanisms of tumor from the host cells and methods for diagnosis of tumor.	5
CO6	Write a report on different immunodeficiency disorders.	6
Title of the Course and Course Code	**Molecular Biology (MIC4203)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive**

		level
CO1	Describe the concepts of epigenetic and the changes which affect the gene expression and the structure, organization and regulation of chromatin.	1
CO2	Compare the complexity of genomes in different species and differentiate between prokaryotic and eukaryotic transcription.	2
CO3	Illustrate different control mechanisms involved in prokaryotic transcription.	3
CO4	Explain the fine control of prokaryotic transcription in metabolism of sugars and amino acids	4
CO5	Distinguish between the controlling elements of different types of transposons	4
CO6	Justify the importance of retroviral transposons and other eukaryotic transposable elements	5
Title of the Course and Course Code	**Practical Course Based on Microbial Metabolism and Molecular Biology (MIC4204)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Identify the microorganisms which can degrade complex polysaccharides like cellulose and chitin.	1
CO2	Transform bacterial cells with recombinant DNA, determine the efficiency of transformation and selection of recombinants	2
CO3	Examine the ability of rhizosphere flora to exhibit PGP traits.	3
CO4	Analyze different methods of isolation of anaerobic bacteria.	4
CO5	Measure the quantity of extracted plasmid DNA using analytical techniques.	5
CO6	Design an experiment for induction of lactose operon and determine the activity of β- galactosidase	6
Title of the Course and Course Code	**Practical Course based on Immunology and Virology / Bionanotechnology (MIC4205)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Perform chemical analysis using Spectrophotometer, conductometer, potentiometer and pH meter and interpret and match the experimental results with standards.	1,2,3,6
CO2	Execute chemical analysis for ores, alloys and prepare metal complexes.	3
CO3	Develop basic skills to prepare and standardize different inorganic solutions.	5,6
CO4	Relate and apply the theoretical principles and concepts to the experimental conducts.	3,4

CO5	Implement problem solving, critical thinking and analytical reasoning as applied to scientific problems.	3
CO6	Represent the results of scientific work in oral, written, graphical and electronic formats.	2
Title of the Course and Course Code	**Practical course based on Immunology and Virology/ Bionanotechnology (MIC4205)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the different types of antigen - antibody interactions using simple immunological techniques such as Ouchterlony technique, Radial immunodiffusion test, Rocket immunoelectrophoresis and latex agglutination slide test	1
CO2	Estimate the titres of isoantibodies to human blood group antigens	5
CO3	Illustrate advanced immunological techniques like ELISA and MTT assay by demonstration.	3
CO4	Analyze separation and proliferation of lymphocytes and response to mitogen stimulus. Explain the working principle of sophisticated instruments such as ELISA reader and FACS seen during the visit to a research institute.	4
CO5	Estimate the virus titre in hemagglutination tests and plaque assays and study phage infectivity in bacteria. Test the ability of biological sources to form nanoparticles and quantitate the same using biophysical techniques.	2,5
CO6	Plan an experiment to understand the various routes of inoculation in embryonated eggs. Develop basic skills to prepare and standardize different inorganic solutions. Validate the observations of chemical analysis using Spectrophotometer, conductometer, potentiometer and pH meter and match the experimental results with standards.	6
Title of the Course and Course Code	**Virology (MIC4206)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List the various emerging, re-emerging viral diseases and their causative agents. State the reasons for their emergence and re-emergence.	1
CO2	Illustrate the structure of viruses. Explain the methods for cultivating viruses.	2
CO3	Illustrate the different methods of replication of DNA and RNA	3

	viruses.	
CO4	Compare different aspects of the life-cycles of different viruses and classify them according to Baltimore's and ICTV methods of classification.	4
CO5	Summarize the mode of actions of different anti- viral agents. Compare the different types of viral vaccines.	5
CO6	Compile the various diagnostic methods for viral infections.	6
Title of the Course and Course Code	**Advanced Bionanotechnology (MIC4207)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the use of food nano biometerials and biocompatibility	1
CO2	Articulate theoretical aspects of surface physics, biomaterials, and methods of the interaction with surfaces and fibres of biomolecules.	2
CO3	Write the processes for production of various types of nanostructured materials.	6
CO4	Explain applications of nanomaterials in bioseparation, diagnostics, drug delivery and bioimplants.	4
CO5	Select the technique for applications within bioseparation, diagnostics, drug delivery and bioimplants.	5
CO6	Design a membrane model by utilization of lipid/polymer nanoparticles for formulation/ administration of drugs.	6
	S.Y. M.Sc. Semester III	
Title of the Course and Course Code	**Biostatistics (MIC5301)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the method to collect samples in the most appropriate way to carry out desired experiments. Record the data obtained in the experiment in a suitable way.	1,2,3
CO2	Design the experiments based on the different principles.	6
CO3	Apply the measures of central tendency, dispersion to the data and calculate the probability of obtaining the expected results in the experiments.	3
CO4	Analyze large data to get a meaningful inference from it.	4
CO5	Compare the different methods of measuring central tendency and evaluate the best suitable one for a particular data	5
CO6	Formulate a hypothesis for the experiment as well as test it using appropriate methods.	5,6
Title of the	**Bioprocess development (MIC5302)**	**Number of**

Course and Course Code		Credits : 04
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe different types of bioreactors, their configuration and working of CSTR.	1
CO2	Explain the principle of transfer of oxygen in the fermentation medium and how agitation helps in it.	2
CO3	Apply the knowledge of biosensors to a successful fermentation process, learn the concept of primary, secondary metabolites and demonstrate it at industrial level.	3
CO4	Analyze the products formed by continuous batch and fed batch fermentations.	4
CO5	Evaluate the production of growth associated and growth non - associated products. Differentiate between primary and secondary metabolites and determine the microbial growth kinetics and apply it to industrial fermentation.	5
CO6	Produce pullulan an exopolysaccharide, the antibiotic TEIXOBACTIN produced by VBNC, streptokinase, a lifesaving drug in heart attacks produced by Streptococcus and recombinant vaccine for Hepatitis B.	6
Title of the Course and Course Code	**Practical Course based on Biostatistics, Microbial Ecology and Applied Molecular Biology (MIC5303)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the sublethal concentrations of different types of plasmid curing agents and classify them based on their effectiveness.	1,4
CO2	Explain the features of programming software R or PAST and its application in data analysis.	2
CO3	Demonstrate the use of enzymes used in rDNA technology.	3
CO4	Test statistical tools for data analysis with the help of t test, ANOVA, Chi square test, F test using computer softwares.	53
CO5	Organize the experimental biological data obtained and validate it using different statistical tools.	4,6
CO6	Develop graph, bar charts, line graphs, pie charts, add error bars.	6
Title of the Course and Course Code	**Practical course based on Bioprocess Development, and Pharmaceutical Microbiology (MIC5304)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe methodology for preparation of Immobilized yeast cells and	1,5

	compare the activity of free cells and immobilized cells.	
CO2	Differentiate between synergistic and antagonistic action of drugs and compare the mode of action of drugs.	2,4
CO3	Develop enzyme lipase from bacteria and apply the knowledge of fermentation parameters to compare the yield of the product.	3,6
CO4	Analyze the pigment produced by bacteria, fungi and characterize them.	4
CO5	Compare different methods for sterility testing of anti-infective-direct inoculation and membrane filtration techniques.	5
CO6	Write methodology involved in LAL test and interpretation of observations.	6
Title of the Course and Course Code	**Microbial Ecology (MIC5305)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe how the environment interacts with the macro and microorganisms and the interactions amongst themselves.	1
CO2	Discuss the interaction between animals and their systems with the microbes as well as the plant interactions with microbes.	2
CO3	Analyze the mechanisms of quantitating ecological aspects, study the laws defining adaptability to environmental conditions and the effect of microbial interactions on different pollutants.	3
CO4	Apply the methods to assess microbial community changes and learn about the environment impact assessment tools.	4
CO5	Evaluate the structure and composition of the microbial community.	5
CO6	Create data on unculturable bacteria, microbial number and microbial metabolism by using knowledge of microbiology and ecology.	6
Title of the Course and Course Code	**Applied Microbiology (MIC5306)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the fundamentals of rDNA technology and the strategies involved in gene cloning.	1
CO2	Compare the different types of vectors used in rDNA technology.	2
CO3	Apply the data generated from different genome projects in diagnosis of genetic diseases and their therapy.	3
CO4	Demonstrate the use of transgenic plants and animals in production of industrially important products.	3
CO5	Compare different molecular diagnostic techniques for detecting different diseases.	5
CO6	Formulate the principles and applications of different molecular biology techniques.	6

Title of the Course and Course Code	**Pharmaceutical Microbiology (MIC5308)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe contributions and state Paul Ehrlich postulates in the drug discovery process.	1
CO2	Differentiate between conventional and rational drug discovery processes and explain different methods of drug discovery processes.	2
CO3	Classify different carriers and drug delivery systems needed in the pharmaceutical industry.	3
CO4	Categorize Adverse Drug Reactions into different types and explain different types of clinical trials of drugs.	4
CO5	Compare different methods for evaluation and mechanism determination of anti-infective.	5
CO6	Write a report on GMPs and GLPs required in the pharmaceutical industry.	6
Title of the Course and Course Code	**Food Technology (MIC5309)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the. Food standards and quality maintenance: FPO, PFA, Agmark, ISI, HACCP, food plant sanitation and cleaning in place (CIP), FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture.	1
CO2	Explain the Principles of Food Analysis: Types of samples analysed, steps in analysis, choice of methods; sampling procedures, considerations and sample preparation	2
CO3	Apply Food as remedies, nutraceuticals bridging the gap between food and drug, nutraceuticals in treatment for cognitive decline, nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycaemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc	3
CO4	Analyze chemical constituents, their characterization and significance- moisture, ash, minerals, lipids, fat, proteins, fibre, titratable acidity, starch, reducing sugars.	4
CO5	Evaluate the data of the food analysis– accuracy and precision, sources of errors, specificity, sensitivity and detection limits, regression analysis, reporting results. Analysis of chemical constituents, their characterization and significance- moisture, ash, minerals, lipids, fat, proteins, fibre, titratable acidity, starch, reducing sugars	5
CO6	Produce some Nutraceutical rich supplements using, Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp	6

	and Spirulina etc	
Title of the Course and Course Code	**Project work and Dissertation-1 (MIC5401) and Project work and Dissertation- 2 (MIC5402)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List the objectives and state the hypothesis of the research project.	1
CO2	Outline the methodology that will be followed to achieve the listed objectives.	2
CO3	Employ the finalised methodology to solve the problem which has been undertaken.	3
CO4	Analyse the data which has been generated by carrying out several experiments.	4
CO5	Evaluate the data – accuracy and precision, sources of errors, specificity, sensitivity and detection limits, regression analysis, reporting results.	5
CO6	Organize the inferences to prove the hypothesis.	6