UTD

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Sri Satya Sai University of Technology and Medical Sciences, Sehore

Outcome Based Curriculum

Programme : Master of science (MICROBIOLOGY)

Vision of the Departments :

As part of an internationally acclaimed University, the Department of Microbiology strives to be in the vanguard of the field of Microbiology, aiming to be recognized as among the best for Microbiology education and scientific research.

Mission of the Departments:

Providing quality education and training to our students, and bringing out the very best in them through the stimulus of scholarly progression and intellectual development. Equipping students with excellence in education and skills to enable them pursue a career of their choice. Cultivating talents and promoting all round personality development through multi-dimensional education to foster a spirit of self-confidence and self-reliance in our students. To prepare them to become responsible contributing citizens of society, who can take up leadership positions around the globe.

Programme Educational Objectives:

At the time of completion of the programme the student will have developed extensive knowledge in various areas of Microbiology. Through the stimulus of scholarly progression and intellectual development the programme aims to equip students with excellence in education and skills, thus enabling the student to pursue a career of his/her choice. By cultivating talents and promoting all round personality development through multi-dimensional education a spirit of self-confidence and self-reliance will be infused in the student. The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individuals.

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About the Programme

The M.Sc. Microbiology programme offered by Delhi University is of two years' duration and is divided into four semesters. The various courses of the programme are designed to include classroom teaching and lectures, laboratory work, project work, viva, seminars, assignments and field trips. Three categories of courses are being offered in this programme: Core Courses (fourteen mandatory courses offered by the Department), Elective Courses (student must opt for two out of four Elective Courses offered by the Department), and Open Elective (student may opt for any one Open Elective offered by either the Microbiology Department or any other Department of the Faculty of Interdisciplinary and Applied Sciences). The Core Courses are of four/eight credits and include classroom as well as laboratory courses. A separate research-based course that leads to a dissertation and is worth twenty-four credits is also one of the Core Courses. The Elective Courses are four credit courses and the Open Elective is also a four credit course. The student is required to accumulate twenty-four credits each semester, a total of ninety-six credits, to fulfill the requirements for a Master of Science degree in Microbiology. Thirty percent of the total marks for each course will be awarded through Internal Assessment. Final examinations for four credit courses will be of three hours duration while examinations for each laboratory-based course will be held over two days of eight hours each or four hours each for eight credit or four credit courses respectively.

PROGRAM SPECIFIC OUTCOMES (PSOs) OF THE PROGRAMME

At the end of the two year programme the student will understand and be able to explain different branches of Microbiology such as Bacteriology and Virology. The student will be able to explain about various applications of Microbiology such as Environmental Microbiology, Industrial Microbiology, Food Microbiology, and Microbial Pathogenicity. He/she will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics, and will be able to execute a short research project incorporating techniques of Basic and Advanced Microbiology under supervision. The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired.

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(06) Programme PO's and PSO's Mapping

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		
S. No	**Program**	**Courses Category**	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	Environment and Sustainability	Ethics	Individual and Team Work	Project Management	Life-Long Learning	**PSO 1**	**PSO 2**
1	**MSc Microbiology**	Humanities and Social Sciences including Management courses	*			*		*			*	*	
2		Basic Science courses	*	*	*	*	*						*
3		Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.											
4		Professional core courses	*	*	*							*	
5		Professional Elective courses relevant to chosen specialization/branch	*	*	*	*		*	*				*
6		Open subjects –	*	*	*	*	*	*	*		*	*	*

		Electives from other technical and /or emerging *subjects											
7		Project work, seminar and internship in industry or elsewhere	*	*	*		*	*	*	*	*		*
8		Specific core subject	*	*	*								
9		Mandatory Course (Non credit)					*	*	*		*		

(07) Semester wise PO's and SPO's Mapping

Sem	Name of the Courses/POs /Basic, Core Electives, Projects, Internships etc.)	PO1 Problem Analysis	PO2 Design/Development of Solution	PO3 Investigation	PO4 Modern Tool Usage	PO5 Environment and Sustainability	PO6 Ethics	PO7 Individual and Team Work	PO8 Project Management	PO9 Life-Long Learning	PSO 1	PSO 2
Sem I	Bacteriology	*	*	*	*			*	*	*	*	
	Virology	*	*	*						*		
	Mycology	*	*	*	*		*			*		*

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	Microbial Biochemistry	*	*	*	*						*	
Sem II	Molecular Biology and Recombinant DNA Technology	*	*	*						*		*
	Biostatistics and Computer Application	*	*	*								
	Microbial Genetics										*	
	Microbial Metabolism	*	*	*								
Sem III	Environmental Microbiology	*	*	*								
	Industrial & Food Microbiology	*	*								*	
	Medical Microbiology	*	*									
	Agricultural Microbiology	*	*									*
Sem IV	Agriculture Microbiology					*		*			*	

	Food Microbiology	*									*	
	Virology and Mycology	*	*									*
	Microbial Immunology	*	*	*							*	

(08) Structure of Programme: To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

Total Hrs.*= 160 Hrs.

Structure of MSc program:

S. No.	Course Category	Hours of the MSc ZOO Curriculum
1.	Bacteriology	11
2.	Virology	24
3.	Mycology	19
4.	Microbial Biochemistry	20
5.	Molecular Biology and Recombinant DNA Technology	18
6.	Biostatistics and ComputerApplication	18
7.	Microbial Genetics	18

8.	Microbial Metabolism	24
9.	Environmental Microbiology	19
10.	Industrial & Food Microbiology	18
11.	Medical Microbiology	18
12.	Agricultural Microbiology	18
13.	Agriculture Microbiology	18
14.	Food Microbiology	24
15.	Virology and Mycology	19
16.	Microbial Immunology	
	Total	

***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

Programme Structure: The M.Sc. Microbiology programme is a two-year course divided into four-semesters. A student is required to complete ninety-six credits for the completion of course and the award of degree. A student has to accumulate twenty-four credits in each of the four semesters.

Part – I	**First Year**	**Semester I**	**Semester II**
Part -II	**Second Year**	**Semester III**	**Semester IV**

Scheme of Examination

I Semester

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	Subject	CCE/INTERNAL		Theory			Practical
		Max	Min	Max	Min	Max	Min
MMB-101	Bacteriology	30	11	70	25	0	0
MMB-102	Virology	30	11	70	25	0	0
MMB-103	Mycology	30	11	70	25	0	0
MMB-104	Microbial Biochemistry	30	11	70	25	0	0
MMB-105	Lab.1 (Based on paper I & II)	0	0	0	0	100	36
MMB-106	Lab.2 (Based on paper III & IV)	0	0	0	0	100	36

SECOND SEMESTER

		CCE/Internal	Theory	Practical	Total

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Code	Course								
		Max	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**
MMB-201	**Molecular Biology and**	30	11	70	25	-	-		
	Recombinant DNA Technology							100	36
MMB-202	**Biostatistics and Computer**	30	11	70	25	-	-		
	Application							100	36
MMB-203	**Microbial Genetics**	30	11	70	25	-	-	100	36
MMB-204	**Microbial Metabolism**	30	11	70	25	-	-	100	36
MMB-205	**Lab.1**	-	-	-	-	100	36		
	(Based on paper I & II)							100	36
MMB-206	**Lab.2**	-	-	-	-	100	36		
	(Based on paper III & IV)							100	36

Third Semester

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Semester	Code	Course	CCE/Internal		Theory		Practical		Total
			Max	Min	Max	Min	Max	Min	
III Semester	MMB-301	Environmental Microbiology	30	11	70	25	-	-	100
	MMB-302	Industrial & Food Microbiology	30	11	70	25	-	-	100
	MMB-303	Medical Microbiology	30	11	70	25	-	-	100
	MMB-304	Agricultural Microbiology	30	11	70	25	-	-	100
	MMB-305	Lab.1 (Based on paper I & II)	-	-	-	-	100	36	100
	MMB-306	Lab.2 (Based on paper III & IV)	-	-	-	-	100	36	100
	Total		120	44	280	100	200	72	600

Fourth- Semester

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Code	Subject	CCE/INTERNAL		Theory		practical	
		Max	Min	Max	Min	Max	Min
MMB401	Agriculture Microbiology	30	11	70	25	0	0
MMB402	Food Microbiology	30	11	70	25	0	0
MMB403	Virology and Mycology	30	11	70	25	0	0
MMB404	Microbial Immunology	30	11	70	25	0	0
MMB-405	Lab.1	-	=	=	=	100	36
MMB-406	Lab.2	-	=	=	=	100	36
MMB-407	Project Work					100	36

Semester-I

Paper-I: Bacteriology

Code: MMB- 101

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MMB-101	**Bacteriology**	**3L:0T:0P**	**36 Hrs**	**3Hrs/Week**

Course Objectives: The primary objective of the course is to build a strong foundation in the area of bacterial cell structure, division, survival and propagation.

Course Learning Outcomes:

Upon successful completion of the course, the student:

CO1: Will be able to describe the morphological features, cell arrangement and structural components of bacterial cell in detail; will be able to differentiate between Gram-positive and Gram-negative bacteria.

CO2: Will have gained knowledge about cell wall structure and extracellular appendages in different bacteria and is acquainted with current methodologies available for production of protoplasts, sphaeroplasts and L-forms.

CO3: Will have gathered detailed information regarding bacterial cell division and endospore formation.

CO4: Can enlist the characteristics of archaea that differentiate it from eubacteria, and will have learnt key features of some model archaeal organisms.

CO5: Can enlist the salient features of the genome organization of E.coli and also the features of the unusual genome organization of selected extremophiles that allow them to survive harsh environments.

CO6: Understands different secretion systems existing in bacteria for toxins and biomolecules secretion, and their role in bacterial survival and pathogenesis.

CO7: Will have gained in-depth knowledge about density-based signal transduction in bacteria and its significance in competence, sporulation and antibiotic resistance; would know about quorum quenching and its use in developing antimicrobial tools.

Contents:

UNIT-I **06 Hrs**

History, scope and development of bacteriology, sterilization, isolation, enrichment, pure culture and staining techniques, systematic study of bacteria; morphological, physiological, biochemical and serological studies.

UNIT-II **06 Hrs**

Habitat, structure, reproduction & classification of bacteria (morphological, biochemical, serological, chemical and molecular aspects), Actinomycetes, Mycoplasma, Rickettsiae, Chlamydiae and their significance.

UNIT-III **06 Hrs**

The photosynthetic bacteria; cyanobacteria, green bacteria, halobacteria and their economic importance. Methanogenic bacteria and their significance. Chemoautotrophs and Methylotrophs; nitrifying bacteria, sulfur oxidizers, iron bacteria, hydrogen bacteria and their economic importance.

UNIT-IV **06 Hrs**

Enterobacteriaceae and related organisms, their morphological & physiological characters, genetic interrelationship, taxonomic sub-division & their importance in human health. Myxobacteria, cytophage group, filamentous & gliding chaemoheterotrophs & filamentous sulphur oxidizing bacteria.

UNIT-V **04 Hrs**

Gram positive spore forming bacteria; unicelluar endospore formers- Bacillus, Clostridia. Miscellaneous bacteria; lactic acid bacteria, Micrococci, Corynebacteria, Mycobacteria.

Text Books

Text Book of Microbiology : RC Dubey and Maheshwari
The Fundamentals of Bacteriology : Charles Bradfield Morrey

Semester-I

Paper-I: Virology

Code: MMB 102

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MMB-102	**Virology**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

The course will facilitate in understanding of molecular virology by examining common processes and principles in viruses to illustrate viral complexity, to understand viral reproduction. The course will teach the strategies by which viruses spread within a host, and are maintained within populations. It covers the molecular biology of viral reproduction and addresses the interplay between viruses and their host organisms

Course Learning Outcomes: Upon successful completion of the course,

CO1: Is able to describe classification of viruses

CO2: Is able to describe tools for studying virus structure, process of virus attachment and entry, virus assembly and release

CO3: Is able to describe steps in replication of genome of RNA viruses, retroviruses, and DNA viruses

CO4: Is able to describe steps in virus infection, transmission, patterns of infection, virus virulence, and host defense against virus infection

CO5: Is able to describe methods of making virus vaccines and anti-viral drugs, drivers of virus evolution, and emerging viruses

Co6: Is able to describe unusual infectious agents, virus mediated cellular transformation and oncogenesis

CO7: Is able to describe evasion strategies used by viruses, and learn to apply their knowledge to investigate virus outbreak

Contents:

UNIT-I **04 Hrs**

General virology: History and development of virology, origin, properties, ultrastructure and chemistry of viruses. virus related agents (viroids, prions), significance of viruses.

UNIT-II **06 Hrs**

General methods for isolation, identification, characterization and cultivation of viruses: Methodology for isolation, adsorption, One-step growth and burst size of virus. Determination of titre value, isolation of phage resistant strain, cultivation and maintenance of plant, animal and bacterial / cyanobacterial viruses. identification of viruses by physical, chemical and serological techniques.

UNIT-III **05Hrs**

Bacterial/ cyanobacterial viruses: Structure and multiplication of lytic and lysogenic bacteriophage. Significance of lysogeny. Brief account of M13, Mu, T4 and λ, history, structure, genetics and life cycle of cyanophages, significance of bacteriophages and cyanophages.

UNIT-IV **06 Hrs**

Plant viruses: classification and nomenclature, structure and multiplication of plant viruses with special reference to TMV, cauliflower mosaic virus, effect of viruses on plants. Some common viral diseases of plants (TMV, CMV, leaf Curl of papaya). Transmission of plant viruses and control of viral diseases of plants.

UNIT-V **05 Hrs**

Animal viruses: Classification and nomenclature of animal and human viruses. Brief account of Adeno-, Herpes, Hepatitis, HIV and other oncogenic viruses. Prevention, treatment and control of viral diseases. Viral vaccines including DNA vaccines and interferons.

Text Books

Basic Virology : Elliott J. Blumenthal
Microbiology : Powar and Daginawala
Textbook of Virology : Vinod Singh

Semester-I Paper-I: Mycology

Code: MMB 103

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MMB-103	**Mycology**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

COURSE OBJECTIVE: To provide a basic understanding of the biology, taxonomy and phylogeny of fungi

COURSE LEARNING Outcomes:

1. Apply principles of safety, quality assurance, and quality control.
2. Apply principles of safety, quality assurance, and quality control.
3. Evaluate specimen acceptability.
4. Describe basic morphology and physiology of parasites and fungi.
5. Classify parasites and fungi.
6. Perform appropriate laboratory techniques used in the processing of specimens and identification of parasites and fungi.
7. Evaluate and correlate test results with patient condition(s).

Contents:

UNIT-I **06 Hrs**

Status of fungi in the living world, general features of fungi and fungus like organisms; recent trends in the classification of fungi; physiology and growth of fungi; nutritional and environmental factors affecting growth; saprotrophs, parasites and mutualistic symbionts; physiology of reproduction in fungi, phylogeny of fungi.

UNIT-II **06 Hrs**

Fungal diversity-major taxonomic group, structure, reproduction, life cycle and significance of the following representatives: i) Gymnomycota-general account – cellular slime moulds (Dictyostelium), plasmodial slime moulds (Myxomycetes). ii) Mastigomycota- Coelomomyces, Lagenidlum, Achlya, Phytophthora, Peronospora, Plasmodiophora. iii) Amastigomycota-Zygomyocotina- Mucor, Syncephalastrum, Blakeclea, Cunninghamella, Entomophthora.

UNIT-III **06 Hrs**

Fungal diversity contd. structure, reproduction, life cycle and significance of the following representatives:

i) Ascomycotina- Taphrina, Emericeilla, Chaetomium, Morchella, Neurospora, Claviceps, Erysiphae.

ii) Basidiomycotina- Puccinia, Melamspora, Ustilago, Polyporus, Lycoperdon, Ganoderma.

iii)Deutromycotina- Fusarium, Cercospora, Curvularia, Beauveria, Microsporum, Phoma, Collectotrichum.

UNIT-IV **08Hrs**

Fungal genetics: i) Life cycle and sexual process in fungi; structure and organization of fungal genomes (mitochondrial genes, plasmids and transposable elements, virus and viral genes). ii) Genetic variations in fungi- nonsexual variations-haploidy, heterokaryosis, parasexuality; sexual variations- mating or breeding systems- homothallism and heterothallism, mutation, physiological specialization; strain improvement.

UNIT-V **06 Hrs**

Fungi and biotechnology: production of alcoholic beverages, antibiotics, organic acids, ergot alkaloids; the cultivation of fungi for food-mushrooms, myco protein and mycofoods; role of fungi in agriculture and forestry- mycorrhizae and their application, mycopesticides, mycotoxins, conservation of fungal germplasm.

Text Books

Introductory Mycology : C J Alexopoulos C W Mims
Textbook of Mycology : SR Mishra

Semester-I

Paper-I: Microbial Biochemistry

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Code: MMB 104

MMB-104	**Microbial Biochemistry**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives: The objective is to offer detailed knowledge about the mechanisms of disease, cause, transmission, detection, treatment and prevention.

Course Learning Outcomes:

- Students will gain overall knowledge about the mechanisms of disease cause, transmission, detection, treatment and prevention.
- Students will develop the ability to relate to any existing or emerging infection as well as will learn about drug resistance and its mechanisms. The students will have the know-how to research and develop new tools for their management.

Contents:

UNIT- I **05 Hrs**

Free energy and spontaneity of reactions. ATP and other phosphorylated compound with their freeenergy of hydrolysis, phosphoryl group transfer; biological oxidation reductions reaction; coupledreaction and oxidative phosphorylation, inhibitors and uncouplerS

UNIT – II **06 Hrs**

Enzyme classification, specificity, active site. Enzyme kinetics Michealis Menton equation, determination of kinetic parameters. Bi-substrate reaction and their kinetics. Enzyme inhibition and kinetics. Allosteric enzyme, kinetics, and allosteric regulation of phospho fructo kinase

UNIT – III **06 Hrs**

Structure and chemistry of macromolecules: proteins, carbohydrates and lipids; protein folding; structure and chemistry of bimolecules such as antibiotics; pigments, vitamins as coenzymes; lipid analysis by GLC and mass spectrometry; oligosaccharide and polysaccharide analysis.

UNIT – IV **06 Hrs**

Biosignaling- Molecular mechanism of signal transduction; gated ion channels, nicotinic- acetyl cholinereceptor; receptor enzyme- the insulin receptor; G- proteins and cyclic AMP; membrane

transportbiomembrane, nutrient transport across membranes, active and passive diffusion, symport, antiport and uniport, Na+ K+ pumps and their metabolic significance.

UNIT – V **03Hrs**

Chromatographic technique- paper and TLC, gel filtration, ion-exchange, affinity; HPLC SDSPAGE, isoelectric focusing, Westerns blotting; protein sequencing, mass spectrometry, MALDITOF– MS.

Text Books

Text Book of Biochemistry : Lehninger and Damodaran M. Vasudevan
Biochemistry : Manisha Bansal

Semester-II

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Paper: Molecular Biology and Recombinant DNA Technology

Code: MMB 201

MMB-201	**Molecular Biology and Recombinant DNA Technology**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives: The objective of this course is to make the student familiar with the currently used methods used to clone genes, make and screen libraries, and the various applications of the polymerase chain reaction. The student will be taught about the methods currently used to carry out genomewide analyses and global analyses of transcription and protein expression. The student will be made familiar with how recombinant DNA technology has been exploited in the study of biology as well as in the production of pharmaceutical product

Course Learning Outcomes: Upon successful completion of the course, the student:

CO1: Will be familiar with the use of various cloning vectors, and methods of DNA, RNA and protein analysis.

CO2: Will be able to describe the various applications of PCR, and know how to make and screen genomic and cDNA libraries.

CO3: Will be able to understand the methods by which DNA is sequenced and will gain insights into how entire genomes of organisms are sequenced

CO4: Will have learnt about promoter analyses, the many uses of the reporter genes, and methods to study the transcriptome.

Co5: Will be aware of the different bacterial and eukaryotic systems available for overexpression of proteins.

CO6: Will have learnt about different methods to analyze protein-DNA and protein-protein interactions, protein engineering, and methods for proteome analyses.

CO7: Will know about the creation of plant and animal transgenics, and about animal cloning

Contents:

Unit-I: **05 Hrs**

Genetic code, Universality of codons, Central dogma, transcription, reverse transcriptase exo and endo nucleases, RNA polymerases, synthesis of RNA in eukaryotes and prokaryotes, operators, exon and introns, post transcriptional processing of RNA.

Unit-II: **06 Hrs**

Translation (protein synthesis) in eukaryotes and prokaryotes, t-RNA synthetase, activation in amino-acids, inhibitors of protein synthesis. Protein folding, Proof reading, wobble effect.

Unit-III: **06 Hrs**

Gene expression, regulation of gene expression, Operon concept, catabolite activator protein (CAP), positive and negative control and gene expression in prokaryotes, Lac Operon and Tryptophan Operon, Britton-Davidson model of gene regulation.

Unit-IV: **04 Hrs**

Extra chromosomal genetic material, types of plasmids, overlapping genes, Transposons and Silent genes, evolutionary significance of Silent genes, Ribonucleoprotein.

Unit-V: **04 Hrs**

Basics of recombinant DNA technology- Vectors used in recombinant technology (Plasmids, phages, cosmids, phagemids, BAC YAC), Genomic and c-DNA Library, Applications of recombinant DNA technology.

REFERENCE BOOKS

MOLECULAR BIOLOGY: DAVID FREIFELDER

Paper Biostatistics and Computer Application
Code: MMB 202

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MMB-202	**Biostatistics and Computer Application**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives: The course will introduce the student to the variety of computational methods currently available for predicting functional behavior of biological systems. The algorithms behind each method and the shortcomings in present methods will be discussed. Students should be able to analyze the output data to predict a biologically relevant function.

Course Learning Outcomes:

Upon successful completion of the course, the student:

CO1: Will be able to access and derive information from various primary and secondary databases

CO2: Will be able to create and usefully interpret the results of a multiple sequence alignment.

CO3: Can create and correctly interpret phylogenetic trees to gain insight into evolutionary path of the target molecule

CO4: Is able to use various algorithms for predicting genes in genomes

CO5: Knows about a variety of databases available that contain knowledge of various aspects of protein structure, function, evolution relationship.

CO6: Will be familiar with different algorithms available for structure comparison in proteins.

CO7: Will be able to create a model of the given target p

Contents:

UNIT-I **05 Hrs**

Importance and scope of statistics in biochemical experimentation; Elements of Probability- Mathematical and Statistical definitions; Addition and Multiplication theorems; Probability Distribution Functions – Binomial, Poisson and Normal; Area under normal distribution curve.

UNIT-II **06 Hrs**

Measures of central tendency: Arithmetic, geometric & harmonic means; Measures of dispersion: range, quartile deviation, variance, standard deviation, coefficient of variation, confidence limits of population mean. Tests of significance hypotheses and errors; student statistics- population mean equals a specified value; equality of 2 independent means (equal & unequal variance), equality of 2 means (paired samples).

UNIT-III **05 Hrs**

Analysis of variance: one-way analysis (sample sizes equal and unequal), completely randomized design; two-way analysis (one observation per cell), randomized block design; multiple comparisons: least significant difference, Duncan's new multiple range test.

UNIT-IV **08 Hrs**

Linear regression: regression diagram and equation, regression coefficient, standard error, significant tests, prediction of dependent variable from the independent variable; linear correlation- scatter diagram, correlation coefficient, standard error, significance tests; relationship between regression and correlation coefficients; Non parametric tests: Chi-square statistics, test of goodness of fit, test of independence of attributes; standard line interpolation.

UNIT-V **06 Hrs**

Introduction to Computers: Basic architecture, generations of computer hardware and software; operating systems-WINDOWS and UNIX; system and application software; introduction to internet- LAN, MAN, WAN, Concept of bioinformatics; application of bioinformatics in microbiology.

Reference Books

Biostatistics : BL Agarwal
Principle of Statistics : SM Shukla and Sahai

Paper: Microbial Genetics

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Code: MMB 203

MMB-203	**Microbial Genetics**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives: The objective of this course is to understand how microorganisms can be used as tools to understand various biological phenomena. The student will become familiar with methods of transfer of genetic material in bacteria, and will understand the biology of lytic and lysogenic phages. The student will be acquainted with the different modes of gene regulation in bacteria, and the importance of bacterial transposition and its applications.

Course Learning Outcomes: Upon successful completion of the course, the student:

CO1: 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

CO2: Is able to explain how plasmid copy number is regulated, can differentiate between Hfrstrains and strains carrying F plasmid, and can construct a genetic map of bacterial genome using conjugation-based method

CO3: 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.

CO4: Is able to list the events in the lytic and lysogenic phases of lambda phage life cycle and the regulatory factors and events involved.

CO5: Can list the outcomes of transposition events, can design strategies to mutagenize bacteria using transposons, can explain the construction of conditional knockouts

CO6: 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. CO7: Will have learnt about the model organisms used in biological studies.

Contents:

Unit-I: **04 Hrs**

DNA as genetic material, Structure of DNA and RNA, DNA replication (Conservative and semi conservative replication), DNA polymerases, conformational flexibility of DNA, structure of chromosome of eukaryotes, giant chromosomes, satellite chromosomes.

Unit-II: **03 Hrs**

Genetic recombination in bacteria transformation, transduction and conjugation. Use of transformation, transduction and conjugation in genetic mapping, Preparation of genetic maps.

Unit-III: **02 Hrs**

Sequencing of nucleic acid (Sanger's and Maxam and Gilbert's Method), Genetic recombination and its prospects.

Unit-IV: **04Hrs**

Mutation: Molecular mechanism of mutation, forward and reverse mutation, transition, transversion, Spontaneous and induced mutation through physical, chemical and radiations, base analogs, Conditional, permissive, lethal mutations, mutation frequency, application of mutagenesis.

Unit-V: **03Hrs**

Repair mechanisms, Enzymology of repair mechanism dark repair, posttranscriptional repair, photoreactivation repair and SOS repair.

REFERENCE BOOKS

A TEXT BOOK OF MICROBIOLOGY: RC Dubey and DK Maheshwari
PRINCIPLES OF GENETICS: M. J. Gardner

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Paper: Microbial Metabolism

Code: MMB 204

MMB-204	**Microbial Metabolism**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

- identify and distinguish genetic regulatory mechanisms at different levels solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction
- identify genes and mutations in non-annotated sequence data from databases by means of relevant bioinformatics programs
- plan basic experiments in microbial genetics concerned with clarifying phenotypes and their relationship with the genotype
- use common methods in microbial genetics
- describe and summarise experimental work in a correct way in a laboratory notebook.

Contents:

UNIT-I **06 Hrs**

Microbial growth: mathematical expression of growth, growth measurement, efficient growth curve, synchronous growth and continuous culture, effect of environmental factors on microbial growth, nutrients diffusion, active transport, group translocation, solutes, temperature, oxygen relations.

UNIT-II **06 Hrs**

Chaemolithotrophy: Sulphur, iron, hydrogen, carbon monoxide, nitrogen oxidations. Methanogenesis, luminescence. Brief account of photosynthetic and accessory pigmentschlorophyll, bacteriochlorophyll, carotenoids, oxygenic, anoxygenic photosynthesis. Electron transport- photoautotrophic generation of ATP, fixation of CO2- Calvin cycle, reverse TCA, carbohydrate anabolism.

UNIT-III **06 Hrs**

Respiratory metabolism: Embden Mayer Hoff pathway, Entner Doudroff pathway, glyoxalate pathway, Krebs cycle, oxidative and substrate level phosphorylation, Pasteur effect, fermentation ofcarbohydrates-homo and heterolactic fermentations. Synthesis of polysaccharidesgluconeogenesis and other pathways.

UNIT-IV **03 Hrs**

Assimilation of nitrogen: Dinitrogen - nitrate nitrogen-ammonia- denitrification, synthesis of major amino-acids, polyamines; peptidoglycan-biopolymers as cell components.

UNIT-V **03 Hrs**

Microbial development, sporulation and morphogenesis, hyphae vs. yeast forms and their significance. Multicellular organization of selected microbes. Dormancy. Endospore-structure, properties and germination.

Reference Books

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Third Semester - Master of Science (Microbiology)

Paper code- MMB-301

MMB-301	Environmental Microbiology	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

The major objective of this paper is to impart knowledge about structure, composition and functioning of microbial communities of diverse environment. The use of microbial population in agriculture, mineral recovery, management of various types of pollutants and conversion processes of various types of wastes into value added products will be discussed.

Course Learning Outcomes: Upon successful completion of the course, the student:

CO1. Will have an overview of the till date developments in the field of environmental microbiology with special emphasis on the role of microbes in mitigating environment pollution.

CO2. Will have become acquainted with various cultural, biochemical and molecular techniques used in understanding microbial diversity.

CO3. Will be knowledgeable about the diversity, adaptations and biotechnological applications of microbes of extreme environment.

CO4. Will be able to describe the role of soil microbes in nutrient transformation, plant-microbe interactions and biotechnology. Also knows about potability of water and its quality control.

CO5. Understands the role of microbes in management of waste plant biomass and can apply knowledge in designing microbe-based processes for pulp, textile, biofuel and animal feed production industries.

CO6. Is able to describe the role of microbes in solid and liquid waste management, gaining knowledge of various methods employed in sewage treatment and solid waste treatment.

CO7. Understands the role of microbes in bioremediation of environmental pollutants like petroleum hydrocarbons, pesticides, plastic and electronic waste; also understands utility of microbes in mineral and oil recovery.

Contents:

UNIT-I **04 Hrs**

1. Microbial ecology: basic concepts, types and microbial habitats, factors affecting microbial population.
2.Microbial interactions: competition, commensalism, parasitism, mutualism, commensalisms, synergism.
3.Population ecology: characteristics of population, population growth curves(r and k selection) population regulation.
4.Conservation and management of microbial diversity: biodeterioration and biodegradation.

UNIT-II **04 Hrs**

1. Microbiology of air: microorganism of air, enumeration of air micro flora.
2. Significance of air micro flora.
3. Brief account of air borne transmission of bacteria, fungi, pollens and viruses.

4. Air borne diseases and their prevention.

UNIT-III **04 Hrs**

1. Soil microbiology: microflora of soil: soil microorganisms associated with plants: rhizosphere, mycorrhizae.
2. Role of microorganisms in organic matter decomposition (cellulose, hemi cellulose, lignin).
3. Bioleaching; introduction, application of bacterial leaching techniques, properties of bioleaching.
4. Microbial degradation of xenobiotics, petroleum and oil spills in environmental decay behaviours and degradative plasmid.

UNIT-IV **04 Hrs**

1. Water microbiology: aquatic microorganisms; fresh water and sea water microflora. Microorganisms and water quality, water pollution.
2. Water purity test and indicator organisms, method used in environmental studies –BOD, COD, DO.
3. Common water born disease and their control measure.
4. Water purification: flocculation, chlorination and purification.

UNIT-V **06 Hrs**

1. Microbiology of waste water and effluent treatments, aerobic process: primary, secondary and tertiary treatment: trickle filter, oxidation ponds and stabilization ponds , principle of aerobic digestion.
2. Bioremediation of contaminations.
3. Extremophiles –acidophilic, alkalophilic, thermophilic microbes with adaptation and application in ecosystem.
4. Microbial biofilms: physiology, morphology, biochemistry of microbial biofilms, mechanism of microbial adherence, beneficial and harmful role of biofilms.

Reference Books

1. Microbial Ecology: Fundamentals and applications, Ronals M, Atlas, fourth edition, Animprint of Addison Wesley Longman. Inc, California

2. Environmental chemistry, A.K. De, Wiley Eastern Ltd., New Delhi

3. Environmental Science, Physical Principles and applications; Egbert Boeker et. al.

4. Comprehensive Biotechnology, vol.4, M.moo-young (Ed-in-chief), Pergmon Press, Oxford.

5. Waste water Treatment for Pollution Control By Soli J Arceivala, Second Edition, Tata McGraw-Hill Publishing Company Limited.

Paper code- MMB-302

MMB-302	**Industrial & Food Microbiology**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

The course will enable students to apply the learning of microbiology concepts toward the exploitation of microbial population for industrial and human benefits. The strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant microbial products and therapeutic p

Course Learning

Outcomes: Upon successful completion of the course, the student:

CO1: Will have gained insight on industrially important microbes, recent developments in fermentation processes and various optimization strategies at fermenter level.

CO2: Understands the concept of sterilization methods and principles of batch and continuous processes.

CO3: Attains knowledge about designing of industrial strains and various media optimization strategies

CO4: Learns about the design, types of fermenters and various critical components of bioreactors

CO5: Is able to describe control parameters, fluid rheology and process constraints in a large scale bioreactor

CO6: Gets introduced to various strategies of product recovery from a fermentation broth

CO7: Acquires knowledge about various industrially relevant microbial products and the

Contents:

UNIT I **04 Hrs**

1. Microorganisms important in food microbiology: molds, yeast and bacteria –general characteristics, classification and importance.

2. Principles of food preservation, preservation by use of high temperature, low temperature, drying and domestication.

3. Chemical preservatives and additives.

4. Preservation by radiation.

UNIT II **04 Hrs**

1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.

2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.

3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.

4. Detection of spoilage and characterization.

UNIT III **06 Hrs**

1. Classification of food borne diseases.

2. Food borne infections: *Brucella, Bacilllus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella* spp.

3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (*Clostridium Botulinum*).

4. Food adulteration and prevailing food standards in India.

UNIT IV **06 Hrs**

1. Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk.

2. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test).

3. Dehydration and pasteurization of milk.

4. Dairy products from microorganisms: Butter, yoghurt and cheese

UNIT **V** **04 Hrs**

1. Microorganisms as source of food: Single Cell Protein (SCP)

2. Mushrooms and food value of mushroom

3. Food conversio acid conversions, soyabean conversions and Bakery

4. Microbiological estimation of food: Sample collection, preparation and analysis techniques

Reference Books:

1. Food science By Norman N. Potler, Joseph H. CBS Publishers and Distributors, New Delhi

2. Food Microbiology , by William C. Frazier and Dennis Fourth edition, Tata McGraw-Hill Publishing Company Limited, New Delhi. Modern Food Microbiology by James M. Jay, Fo, CBS Publishers, New Delhi.

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Third Semester - Master of Science (Microbiology)

Paper code- MMB-303

MMB-303	**Medical Microbiology**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

Medical Microbiology course has been formulated to impart basic and medically relevant information on the microbes (Bacteria, fungi, viruses and parasites). The microbial structure, growth and development, methods and sterilization techniques in the context of study of microbes are included. The pathogenic microbes and the diseases caused by them are included to broaden the perspective of the subject. Lastly the course deals with the problem of emerging antimicrobial resistance with reference to known pathogens. The course has been designed to get integrated practical based knowledge about medically important bacteria, fungi, viruses and parasites. The students will be able to understand the structure and function of medically important bacteria, fungi, viruses and parasites. In addition they will also understand pathogenesis, diagnosis, clinical features, virulence factors and treatment strategies of medically important bacteria, fungi,

Course Learning Outcomes:

- Medical Microbiology is one of the foundation courses for the biomedical sciences students.

- Students will gain insights on the nature of various infectious agents and diseases pathologies caused by common bacteria, fungi and viruses (for eg. urogenital infections, Blood and CNS infections, fungi such as Candidiasis, aspergillosis and viruses such as hepatits, Dengue, Zika)

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

UNIT-I **04 Hrs**

1. Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors.

2. Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence.

3. Normal microflora of human body: normal flora of skin, respiratory, gastrointestinal, genital tract, role of resident flora, concept of probiotics.

4. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.

UNIT-II **04 Hrs**

1. Infections caused by Gram positive cocci and Gram negative cocci: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Staphylococcus, Streptococcus* and *Neisseria* **(**meningitis, gonorrhea)

2. Infections caused by Gram negative bacteria of family Enterobacteriaceae: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *E.coli, Klebsiella, Proteus, Pseudomonas, Shigella dysenteriae* and *Salmonella typhi.*

3. Infection caused by Gram Positive bacilli: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Corynebacterium diphtheriae, Bacillus anthracis,Clostrodium tetani, Vibrio cholerae*.

4. Disease caused by acid-fast bacteria and intracellular bacteria: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Mycobacterium tuberculosis, Mycobacterium leprae, Rickettsia* and *Chlamydia.*

UNIT-III **04 Hrs**

Morphology, pathogenesis, immune response, diagnosis and prevention of

1. Pox viruses (Variola, Vaccinia, Small pox) Herpes Simplex type I and type II, Picorna viruses (Entero viruses and Polio viruses).

2. Paramyxo viruses (Rubella virus and Para influenza viruses), Orthomyxo viruses (Measles & Mumps viruses).

3. Hepatitis viruses (Type A, B, C, D, E), Arbo viruses (Alpha virus and Flavi viruses), Rhabdo viruses (Rabies virus).

4. Oncogenic viruses, HIV virus.

UNIT-IV **04 Hrs**

1. Important protozoal diseases: Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Plasmodium vivax, P. falciparum, P. malariae* (Malaria), *Entamoeba histolytica* & *Entamoeba coli* (amoebiasis),

2. Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Leishmania, Trypanosoma* and *Toxoplasma.*

3. Fungal infections: description & classification of pathogenic fungi, Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)

4. Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis of Candidiasis, Aspergillosis and Histoplasmosis.

UNIT-V **06 Hrs**

1. Antimicrobial agents: Histroy, Antibiotics, Antifungal and Antivirals (common drugs, their spectrum and mode of action)

2. Methodologies for testing of antibacterial, antifungal, and antiviral drugs (*in vivo* and *in vitro* infectivity models), mechanism drug resistance.

3. Preclinical development: Safety profile of drugs (Pyrogenecity, Toxicity –hepato, - nephro, -cardio and neurotoxicity)**,** Toxicological evaluation of drug (LD50, Acute, subacute and chronic toxicity)**,** Mutagenecity (Ames test, micronucleus test) and Carcinogenicity.

4. Clinical studies: Phase I, phase II, phase III and phase IV of clinical trials –Objectives, Conduct of trials, Outcome of trials.

Reference Books

1. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press.

2. Brock Biology of Microorganisms, M.T, Madigan, J.M. Martinko and J. Parker, Ninth edition, Prentice Hall, Upper Saddle River, NJ.

3. Microbiology: An introduction, G.J. Tortora, B.R. Funke and C.L. Funke.

4. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Paper code -MMB-304

MMB-304	Agricultural Microbiology	3L:0T:1P	36 Hrs	3Hrs/Week

UNIT I **04 Hrs**

1. Microorganisms of soil
2. Rhizosphere and phyllosphere microflora
3. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.
4. Nutrient cycle: Carbon cycle, nitrogen cycle, phosphorous cycle and sulphur cycle.

UNIT II **04 Hrs**

1. Role of enzymes and toxins in pathogenesis.
2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.
3. Bacterial diseases of plants : Citrus canker, blight of rice
4. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady's finger

UNIT III **04 Hrs**

1. Physical and chemical control of plant diseases.
2. Bacterial control of insect pests: *Bacillus thuringiensis* as bacterial insecticide
3. Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV)
4. Fungal control of insect pests: Entomopathogenic fungi : *Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni*

UNIT IV **04 Hrs**

1. Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects.
2. Mycotoxins and their effect on human being.
3. General idea about quarantine.
4. Production of biogas and alcohol from agricultural wastes.

UNIT V **04 Hrs**

1. Biofertilizers : Types, production and application.
2. Mycorrhizae : Types and their application in agriculture and forestry.
3. Vermicomposting.
4. Reclamation of waste agricultural land by microorganisms.

Reference Books

1. Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing CO. PVT., LTD., New Delhi
2. Introduction to soil microbiology. Alexander M. (1977) John Wiley & Sons, Inc., New York.

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

IV- Semester Syllabus

MB: 401 - AGRICULTURE MICROBIOLOGY

MMB-401	AGRICULTURE MICROBIOLOGY	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

This course will help students in understanding of the diverse group of soil microorganisms, its function and its applications

Student Learning Outcomes:

On completion of the course the student will be able to:

1. Know the diverse group of microorganism
2. Understand growth and development of microorganisms
3. Understand the nutrient sources and cycles
4. Develop an understanding about the beneficial affect of soil microorganisms on plant community 5. Know the application of microbiology

Contents:

UNIT I **04 Hrs**

1. Microorganisms of soil
2. Rhizosphere and phyllosphere microflora
3. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.
4. Nutrient cycle: Carbon cycle, nitrogen cycle, phosphorous cycle and sulphur cycle.

UNIT II **04 Hrs**

1. Role of enzymes and toxins in pathogenesis.
2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.
3. Bacterial diseases of plants : Citrus canker, blight of rice
4. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady's finger

UNIT III **04 Hrs**

1. Physical and chemical control of plant diseases.
2. Bacterial control of insect pests: *Bacillus thuringiensis* as bacterial insecticide
3. Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV)

4. Fungal control of insect pests: Entomopathogenic fungi : *Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni*

UNIT IV **04 Hrs**

1. Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects.
2. Mycotoxins and their effect on human being.
3. General idea about quarantine.
4. Production of biogas and alcohol from agricultural wastes.

UNIT V **04 Hrs**

1. Biofertilizers: Types, production and application.
2. Mycorrhizae: Types and their application in agriculture and forestry.
3. Vermicomposting.
4. Reclamation of waste agricultural land by microorganisms.

Reference Books

1. Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing CO. PVT., LTD., New Delhi
2. Introduction to soil microbiology. Alexander M. (1977) John Wiley & Sons, Inc., New York.
3. Modern Soil Microbiology, Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Marcel Dekker INC, New York.

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Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

MMB: 402- FOOD MICROBIOLOGY

MMB-402	**FOOD MICROBIOLOGY**	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

Course Objectives:

The course will enable students to understand the taxonomical classification, phenotypic and biochemical identification of food associated molds, yeasts, yeast-like fungi and bacteria. The course will teach the strategies to develop fermented and non-fermented milk products, plantbased products, fish products, meat products bioactive compounds and malt beverages, wines, distilled liquors and vinegar. The role of microbes in food spoilage, preservation and various food borne diseases will be discussed.

Course Learning Outcomes: Upon successful completion of the course, the student:

CO1: Will know about production and evaluation of the quality of starter cultures and fermented milk products and understands the use and production of probiotics, prebiotics and nutraceuticals

CO2: Is aware of fermentation protocols for production of microbial biomass such as edible yeasts, mushrooms, single cell proteins and single cell oils. The student also learns about production of microbial carotenoid pigments such as lycopene and β-carotene.

CO3: Gathers information regarding microbes causing food intoxications and food-borne infections. CO4: Knows traditional food preservation techniques including drying, salting, pickling, refrigeration, freezing, oxidation, vacuum packaging, canning/bottling, smoking, sugaring, chemical preservation and irradiation.

CO5: Is able to utilize modern techniques viz. high-pressure processing (HHP), bacteriocins, manosonication (MS) and pulsed electric field (PEF) for effective food preservation. The student can also calculate kinetics of inactivation, process and product parameters.

CO6: Gains knowledge about conventional methods for food quality analysis and is able to use the most recent and non-invasive techniques of quantification and detection of food borne microbes and pathogens such asESS and various new imaging techniques.

CO7: Understands the relevance of microbial standards for food safety, quality assurance programs that revolutionize foo

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Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Contents:

UNIT -I **04 Hrs**

1. Microorganisms important in food microbiology: molds, yeast and bacteria–general characteristics, classification and importance.
2. Principles of food preservation, preservation by use of high temperature, low temperature, drying and desiccation.
3. Chemical preservatives and additives.
4. Preservation by radiation.

UNIT II **04 Hrs**

1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.
2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.
3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.
4. Detection of spoilage and characterization.

UNIT III **04 Hrs**

1. Classification of food borne diseases.
2. Food borne infections: *Brucella, Bacilllus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella* spp.
3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (*Clostridium Botulinum*).
4. Food adulteration and prevailing food standards in India.

UNIT IV **04 Hrs**

1. Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk.
2. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test).
3. Dehydration and pasteurization of milk.
4. Dairy products from microorganisms: Butter, yoghurt and cheese.

UNIT V **04 Hrs**

1. Microorganisms as source of food: Single Cell Protein (SCP)
2. Mushrooms and food value of mushrooms
3. Food conversions: Lactic acid conversions, soyabean conversions and Bakery
4. Microbiological estimation of food: Sample collection, preparation and analysis techniques

Reference Books

1. Food science By Norman N. Potler, Joseph H. Hotchkiss. Fourth edition, CBS Publishers and Distributors, New Delhi
2. Food Microbiology , by William C. Frazier and Dennis C. Westhoff, Fourth edition, Tata McGraw-Hill Publishing Company Limited, New Delhi
3. Modern Food Microbiology by James M. Jay, Fourth Edition, CBS Publishers and Distributors, New Delhi.

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Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

MMB-403	AGRICULTURE MICROBIOLOGY	**3L:0T:1P**	**36 Hrs**	**3Hrs/Week**

**Course Objectives: **

The course will facilitate in understanding of how pathogens interact with various plants and effect plant physiology, photosynthesis, respiration, transpiration and translocation. The involvement of various enzymes and toxins and understanding the molecular interaction will help in designing biocontrol strategies and development of transgenic plants. The course covers the novel molecular diagnostic approaches and correct forecasting of plant diseases.

Course Learning Outcomes:

Upon successful completion of the course, the student: CO1: Will have acquired knowledge about cause of plant diseases and effect of microbial infections on plant physiology, photosynthesis, respiration, transpiration, translocation

CO2: Will have learnt about various enzymes and toxins in plant diseases and also role of phytoalexins

CO3: Understands about crown gall, symptoms of viral diseases and their control, diseases of some important cereals, vegetables and crops

CO4: Will have gained insight into genetics of host-pathogen interactions, resistance genes, resistance mechanism in plants.

CO5: Will have been introduced to plant disease control, physical, chemical and biological methods of disease control

CO6: Will have attained knowledge about designing of molecular diagnosis of plant disease and development of transgenic plants with applications and constraints.

CO7: Is able to describe various important milestones in disease control and disease forecasting

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SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

UNIT- I **04 Hrs**

1. Brief outline on discovery and origin of viruses.
2. General properties of viruses, morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
3. Viral genome; their types and structure, viral related agents-viroids and prions.
4. Classification and general properties of major families of viruses including detail account of their mode of replication.

UNIT-II **04 Hrs**

1. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture.
2. Assay of viruses: physical and chemical methods, plaque method, pock counting and end point method.
3. Serological methods: hemagglutination, hemagglutination inhibition, neutralization test, complement fixation, ELISA, RIA.
4. Purification of viruses: gradient centrifuge, electrophoresis, and chromatography.

UNIT-III **04 Hrs**

1. Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV.
2. Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell.
3. Animal viruses: nomenclature and classification of animal viruses.
4. General idea about Cyanophage, and Mycophage.

UNIT-IV **04 Hrs**

1. Bacteriophage: classification, morphology and ultra structure.
2. One step growth curve (latent period, eclipse period, and burst of size.)
3. Life cycle: lytic and lysogenic life cycle of bacteriophages.
4. Brief account of M13, Mu, T4, Ø x174 and lambda phage

UNIT-V **04 Hrs**

1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.
2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.
3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.
4. Ecology of fungi: concept of fungistatic, fungicidal.

Reference Books

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA

2. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
3. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press .

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Outcome based Curriculum for

Postgraduate Degree Courses in MSc -Microbiology

Course Objectives: The objective of this course is to understand the various components of the host immune system, their structure and organization, and functions to serve as the defense system of the body. It would also make the students understand the operational mechanisms which underlie the host defense system, allergy and organ transplantation.

Course Learning Outcomes:

Upon successful completion of the course, the student: CO1: Will be able to understand the fundamental bases of immune system and immune response CO2: Will be able to gather information about the structure and organization of various components of the immune system CO3: Will be able to understand the genetic organization of the genes meant for expression of immune cell receptors and the bases of the generation of their diversity CO4: Will be able to understand the operation and the mechanisms which underlie the immune response CO5: Will be able to apply the knowledge gained to understand the phenomena like host defense, hypersensitivity (allergy), organ transplantation and certain immunological diseases

Contents:

UNIT-I **04 Hrs**

1. History of immunology, development of immunology as discipline.
2. Immune response: mechanism of innate and adaptive immune response.
3. Hematopoiesis: development of immune cells, regulation of hematopoiesis.
4. Structure, composition and types of cells involve in immune response: mononuclear cells, granulocytes, antigen presenting cells, lymphoid cells. Mediators and process of Inflammation.

UNIT-II **04 Hrs**

1. Anatomical organization of immune system: primary and secondary lymphoid organs: structure and function.
2. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T-cell epitopes, haptens, mitogens, super antigen, adjuvants.
3. Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes, molecular mechanism of antibody diversity and class switching.
4. Cell mediated immunity and its mechanism.

UNIT-III **04 Hrs**

1. Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases.
2. Complement system: components, activation pathways, regulation of activation pathways and role of complement system in immune response.
3. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immune receptors.

4. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases, helminthes related diseases.

UNIT-IV **04 Hrs**

1. Hypersensitivity: type I, II, III and types IV hypersensitivity. Immunodeficiency diseases: primary and secondary immunodeficiency.
2. Autoimmunity: organ specific autoimmune diseases, mechanism of autoimmune diseases and therapeutic approaches.
3. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.
4. Cancer immunology: tumor antigen, immune response to tumor, oncogene and induction, cancer immunotherapy.

UNIT-V **04 Hrs**

1. Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotype vaccine.
2. Hybridoma technology: murine monoclonal antibody production, principle of selection, characterization and applications in diagnosis, therapy and basis research.
3. Antibody engineering: Chimeric and Humanized monoclonal antibodies.
4. Antigen- antibody interaction: avidity and affinity measurements, detection of antigen- antibody interaction by precipitation, agglutination, RIA, and ELISA.

Books

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman; 2006.
2. Cellular and Molecular Immunology by Abbas AK, Lichtman AH, Pillai S: Saunders Elsevier; 2007.
3. Immunobiology: The immune system in health and disease by Janeway CA,Travers P,Walport M, Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.
4. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.

PRACTICALS

MB: 405- Lab-I

1. To study viral diseases in plants.
2. To study bacterial and fungal diseases in plants.
3. Isolation of rhizobia from root nodules of leguminous plants.
4. Testing of nodulation ability of rhizobia.
5. Inoculation of seeds with rhizobia.
6. To study pesticidal activity of *Bacillus thuringiensis*.
7. Isolation of VAM spores from soil.
8. Isolation of *Azotobacter* species from soil.
9. Isolation of microorganisms from rhizosphere.

MB: 406 Lab II

1. Detection of adulterants in spices, pulses, sugar, tea.
2. Detection of adulterants in milk and milk products.
3. Detection of arsenic by microbiological methods.
4. Detection of nicotinic acid by bioassay.
5. Detection of number of bacteria in milk by SPC.
6. Determination of quality of milk sample by methylene blue reductase test.
7. To demonstrate role of yeast in bread-making.
8. Isolation of microorganisms from spoiled food.
9. Isolation of pathogenic microorganisms from food.