AMENDMENTS AS RECOMMENDED BY BOARD OF STUDIES 2021-22 (Date: 24.05.2021)

M.Sc. (MICROBIOLOGY & IMMUNOLOGY) COURSE CURRICULUM

(w.e.f. Session 2021-22)

INSTITUTE OF APPLIED SCIENCES & HUMANITIES

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COURSE STRUCTURE

M.Sc.

(MICROBIOLOGY & IMMUNOLOGY)

First Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMC 0001	General Microbiology	Core	4	0	0	4	4
2.	MMAS 0501	Advanced Biostatistics	GE	3	1	0	4	4
3.	MSBC 0001	Biochemistry	Core	4	0	0	4	4
4.	MSBC 0004	Biophysical Techniques	Core	4	0	0	4	4
5.	MSBC 0003	Bioinformatics	Core	4	0	0	4	4
PRACTICALS								
6.	MSMC 0801	General Microbiology & Biostatistics Lab	Core	0	0	3	2	3
7.	MSMC 0802	Biochemistry & Biophysical Techniques Lab	Core	0	0	3	2	3
8.	MSBC 0802	Bioinformatics Lab	Core	0	0	3	2	3
Total				**19**	**1**	**9**	**26**	**29**

Second Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMC 0002	Systemic Bacteriology and Mycology	Core	4	0	0	4	4
2.	MSMC 0003	Systemic Virology	Core	4	0	0	4	4
3.	MSBC 0005	Immunology	Core	4	0	0	4	4
4.	MSBC 0006	Genetics & Molecular Biology	Core	4	0	0	4	4
5.	BELH 0012	Introduction to Gender and Womens studies	GE	4	0	0	4	4
PRACTICALS								
6.	MSMC 0803	Bacteriology & Mycology Lab	Core	0	0	3	2	3
7.	MSBC 0805	Immunology Lab	Core	0	0	3	2	3
8.	MSMC 0804	Genetics, Molecular Biology and Virology Lab	Core	0	0	3	2	3
Total				**20**	**0**	**9**	**26**	**29**

Third Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMC 0004	Fermentation Technology and Industrial Microbiology	Core	4	0	0	4	4
2.	MSMC 0005	Food, Dairy and Agricultural Microbiology	Core	4	0	0	4	4
3.	MSBC 0011	RDT, Genomics & Proteomics	Core	4	0	0	4	4
4.	MSMC 0006	Advanced Immunology	Core	4	0	0	4	4
Electives (Select any Two)								
5.	MSME 0001	Environmenmental Microbiology	Elective	4	0	0	4	4
6.	MSBE 0001	Nanobiotechnology	Elective	4	0	0	4	4
7.	MSBE 0002	Enzyme Technology	Elective	4	0	0	4	4
8	MSBE 0103	Clinical Research in Medicinal Plants	Elective	4	0	0	4	4
9	MSME 0002	Animal Cell Culture	Elective	4	0	0	4	4
Electives (Select any One)								
10	MSBE 0005	Nutritional Biochemistry	Elective	4	0	0	4	4
11	MSBE 0006	Drug Discovery and Development	Elective	4	0	0	4	4
12	MSBE 0007	IPR, Patent, Trademarks & Bioethics	Elective	4	0	0	4	4
PRACTICALS								
13.	MSMC 0805	Fermentation Technology, RDT & Genomics & Proteomics Lab	Core	0	0	3	2	3
14.	MSMC 0806	Food, Dairy, Agricultural Microbiology & Advanced Immunology Lab	Core	0	0	3	2	3
PRACTICALS BASED ON ELECTIVES (Select any Two)								
15.	MSME 0801	Environmental Microbiology Lab	Elective	0	0	3	2	3
16.	MSBE 0801	Nanobiotechnology Lab	Elective	0	0	3	2	3
17.	MSBE 0802	Enzyme Technology Lab	Elective	0	0	3	2	3
18.	MSBE 0803	Clinical Research in Medicinal Plants Lab	Elective	0	0	3	2	3
19	MSME 0802	Animal Cell Culture Lab	Elective	0	0	3	2	3
Total				**28**	**0**	**12**	**36**	**40**

Fourth Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMJ0971	Project Work (Six Months)		0	0	0	16	-
Total				**0**	**0**	**0**	**16**	**-**

S. No.	Category	Subject	Credit	Total Credits
1	Core (Theory)	12	4	48
2	Core (Practical)	8	2	16
3	GE	2	4	8
4	Electives (Theory)	2	4	8
5	Electives (Practicals)	2	2	4
6	Elective	1	4	4
7	Project	1	16	16
8	Total Credits			104

SYLLABUS

M.Sc.

(MICROBIOLOGY & IMMUNOLOGY)

MSMC 0001 : GENERAL MICROBIOLOGY

COURSE OBJECTIVES: Since microbes are ubiquitous and play role in most of spheres in the universe. Discuss about the historical concept of spontaneous generation and how Koch's postulates are used to establish the causal link between a suspected microorganism and a disease and describe some of the various activities of microorganisms that are beneficial to humans.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Overview of Microbiology and its significance. Classification of bacteria, General characters of Archaebacteria, General characters of Cyanobacteria; Their ultrastructure, reproduction and economic importance. Prokaryotic Cell - Ultrastructure and Characteristics of Prokaryotic Cell. Morphology of bacteria, bacterial cell wall, Archaeal cell walls, Cell membrane, Cytoplasmic matrix, The nucleoid, Extra chromosomal nuclear material, Intra cytoplasmic structures, Protein secretion in prokaryotes, Structures external to the cell wall (flagella, fimbrae and pili)- structure and functions. Sterilization and Disinfection – Definitions, Physical and chemical methods. Culture media- Definition, Preparation and their types. Culture Preservation and Maintenance – Freeze drying (lyophilization, liquid nitrogen, storage at -70^{0}C, gelatin discs, mineral oil, sub-culturing etc.) Microbial Nutrition, Growth and Metabolism - Common nutrient requirements, Nutrient based classification of Microorganisms, Growth factors, Growth curve, Continuous and batch culture of microorganisms. Uptake of nutrients by the bacterial cell. Peptidoglycan synthesis. Eukaryotic Cell – The evolution of eukaryotes, Ultrastructure and Characteristics of Eukaryotic Cell. Flagella and cilia. The cell wall and Glycocalyx, The Plasma membrane, cytoplasm, Cell orgenelles – Golgi complex, Lysosomes, Vacoules, Mitochondria, Chloroplast, Peroxisomes, Centrosome.	18
II	General characteristics of fungi, Classification of fungi of medical importance (by Alexopoulos), Economic importance of fungi. Mutalism and symbiosis with plants and animals. Heterothallism, parasexuality, sex hormones in fungi. Diversity of endo and ecto mycorrhizal fungi. Biology of arbuscular mycorrhizal fungi: penetration and colonization inside roots, culturing and benefits, recent advances in the field of mycorrhiza. General characteristics of algae, Classification of algae (by Frisch),	24

	Economic importance of algae. Algae and biofuel, Origin and evolution of sex in Algae. Structure and reproduction of *Volvox, and Sargassam*. Brief outline on discovery of virus, terms & definition of virology, nomenclature and classification of viruses, distinctive properties of viruses, morphology, symmetry and ultrastructure of viruses including bacteriophages. Pathogenesis of Microbes- Pathogenesis of microorganisms, Host-parasite relationships, pathogenesis of bacterial infection Toxigenecity (Exotoxin and Endotoxins, mechanism of action of bacterial toxins), Host defense against microbial invasion, Microbial mechanisms for escaping host defenses. Antimicrobial Therapy- Development of chemotherapy, General Characteristics of antimicrobial drugs, Antibacterial and Antifungal drugs, Drug Resistence.	

Text Book:

- M.J. Pelezar, E.C.S.Chan N.R.Krieg, "Microbiology": McGraw Hill Education, 2001.

Reference Books:

- G.J Tortora, B.R., Funke, C.L. Case, "Microbiology- An Introduction": Pearson Publication, 2016.
- R. Stainer, J. Ingharam, M. Wheelis and P. Painter, "General Microbiology": Palgrave Macmillan, 2003.
- Presscott, Herley and Klein, "Microbiology": McGraw-Hill Science, 2007.
- R.C. Dubey and D. K. Maheshwari, "Textbook of Microbiology": S. Chand Publication, 2010.

Course Outcome: The major outcome of this course are-

CO1- Identify the major categories of microorganisms and analyze their classification, diversity, and ubiquity.

CO2- Help students understand history, biology of microorganisms, growth and control of microbes.

CO3- Thus the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO1, PSO2
CO2	PO1, PO3, PO5, PO7, PO8/PSO2, PSO4
CO3	PO2, PO4, PO5, PO6, PO8/PSO1, PSO3

MMAS 0501: ADVANCED BIOSTATISTICS

OBJECTIVES: To make the students understand the advanced concepts of biostatistics, algebra and differential equations.

Credits: 04 **Semester** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Introduction to Vector algebra, Scalar & Vector triple products, Collinear and Coplanar vectors, Determinant and its properties, Adjoint and Inverse of a matrix (simple problems), Formation of ordinary differential equations (ODEs), Solution of ODE of I order and I degree (Variable separable and Linear forms only). Introduction to Biostatistics, Revision of measures of central tendency and dispersion,	18
II	Computation of moments, Skewness and Kurtosis by the method of moments, Introduction to probability, Additive and multiplicative laws, Conditional probability. Method of least squares for fitting of exponential curves, Sampling, Testing of hypothesis, Type I and type II errors, Level of Significance, Degree of freedom, Students' t-test, F–test, Chi-square test as a goodness of fit and as a test of independence, ANOVA (one way classification).	24

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Equations, Atlantic Publishers and Distributors, Delhi, 2008.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.

COURSE OUTCOMES: By the end of this course, the students will be able:

CO1- To recognize and give example of different type of data arising in public health and clinical studies.

CO2- To interpret difference in data.

CO3- To select an appropriate test for comparing populations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO1, PSO2
CO2	PO1, PO2, PO4/PSO1
CO3	Po1, PO6, PO7,PO8/PSO2

MSBC 0001: BIOCHEMISTRY

COURSE OBJECTIVES: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of lecture series.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	*Carbohydrates* **Glycolysis**: definition, location, reactions, stoichiometry, fate of pyruvate, ATP production, energetics of Glycolysis, regulation **Kreb's cycle:** definition, location, pyruvate dehydrogenase enzyme complex, reactions, stoichiometry, amphibolic nature, energetics of TCA cycle, regulatio, Mitochondrial electron transport and oxidative phosphorylation. Anaerobic respiration in bacteria. **Alternative pathways of Carbohydrate metabolism:** pentose phosphate pathway (function, location, reactions, stoichiometry, regulation), uronic acid pathway, metabolism of fructose, metabolism of lactose, metabolism of amino sugars *Amino acids* **Biosynthesis of amino acids:** biosynthesis of alanine, aspartate, asparagine, glutamate, glutamine, arginine, proline, serine, glycine, cysteine, tyrosine, feed back regulation of amino acid biosynthesis. **Amino acid degradation:** transamination, oxidative deamination, conversion of alanine, serine and cysteine into pyruvate, conversion of aspartate and asparagines into oxaloacetate, conversion of glutamine, histidine, arginine, proline into α- ketoglutarate through glutamate, conversion of methionine, isoleucine, valine into succinyl-CoA, catabolism of phenylalanine, tyrosine and tryptophan	18
II	*Lipids* **Biosynthesis of fatty acids:** formation of malonyl CoA, fatty acid synthase complex, reactions of fatty acid synthase, elongation of fatty acid chains, regulation of fatty acid biosynthesis. **Fatty acid oxidation:** activation of fatty acids, role of carnitine in transport of long chain fatty acid, β oxidation of saturated and unsaturated fatty acids, oxidation of odd chain fatty acids, regulation of fatty acid oxidation *Nucleic acids* **Biosynthesis of Purine and Pyrimidine Nucleotide:** De novo synthesis of purine nucleotides, regulation of De novo synthesis of purine nucleotides, salvage pathway for purine nucleotides, De novo synthesis of pyrimidine nucleotides, regulation of pyrimidine synthesis, salvage pathway for pyrimidine nucleotides, formation of deoxy ribonucleotides Degradation of Purine and Pyrimidine nucleotides. **Inborn errors of metabolism:**Protein- PKU, Alkaptonuria, Maple syrup & Gauchers disease Carbohydrates: glycogen storage disorders, Cori's disease & Pomes disease Lipids- Atherosclerosis. Nucleic acids- Gout, Lesch-Nyhan syndrome, Sickle cell anaemia	24

Text Book:

- J.L. Jain, S. Jain and N. Jain, "Fundamental of Biochemistry": S. Chand & Company Pvt. Ltd, 2016

Reference Books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, "Biochemistry" : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, "Lehninger Principles of Biochemistry" : W.H. Freeman,
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Course Outcome: The major outcomes of this course are:

CO1- Describe the Metabolism of carbohydrates, lipids and its regulation
CO2- Describe the metabolism of amino acids, nucleic acids and its regulation
CO3- To understand the concept of inborn errors of metabolism

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO7/PSO1, PSO2
CO2	PO2, PO4, PO5, PO8/PSO1, PSO2
CO3	PO1, PO3, PO5, PO6, PO8/PSO1, PSO2

MSBC 0004: BIOPHYSICAL TECHNIQUES

OBJECTIVES: To provide scientific understanding of analytical techniques and detail interpretation of results.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **Microscopic techniques**: Principle of light microscopy, Phase contrast microscopy, Fluorescence microscopy, Scanning and Transmission Electron Microscopy, Staining procedures in light and Electron microscope, Confocal microscopy, Atomic force microscopy • Centrifugation: Principle, RCF, Rate Zonal and isopycnic density gradient centrifugation, Preparative and analytical ultracentrifuges, molecular weight determination, sedimentation analysis • **Chromatography techniques:** TLC, Gel filtration chromatography, Ion –Exchange chromatography, Affinity chromatography, Tandom affinity purification, Gas-liquid chromatography, HPLC	18
II	• **Electrophoresis techniques:** Principle and application of PAGE, SDS-PAGE, Iso-electric focusing, 2D electrophoresis, Agarose gel electrophoresis, Pulse Field Gel Electrophoresis, Orthogonal field alteration gel electrophoresis, Southern, Northern and Western blotting. • **Spectroscopic techniques:** Principle and application of UV, Visible and IR spectroscopy, Fourier transform IR spectroscopy, Fluorescence spectroscopy, ESR, NMR, Atomic absorption spectroscopy, Mass spectroscopy, Raman spectroscopy, ORD and CD spectroscopy, X-ray crystallography, Flow cytometry	24

Text Book:

- Biological Instrumentation & Methodology by Bajpai, P.K

Reference Books:

- Principle and Techniques in Biochemistryand Mol. Biology, by Keth, Wilson and Walker.
- Protein Purification Principle and Practices by Scopes, Robert K.
- Tools in Biochemistry David Cooper.
- Methods of Protein and Nucleic acid Research, Osterman Vol I – III.
- Principle of Instrumentation analysis by Skoog & West.
- Biophysical Chemistry by Upadhyay & Nath.
- Physical Biochemistry: Application to Biochemistry and Molecular Biology by Freilder.

COURSE OUTCOMES: The major outcomes of this course are:

CO1- To assimilate the principles and applications of centrifuge, electrophoresis and chromatography in research and related experiments.

CO2- Students could amalgamate classical analytical chemical techniques with modern technologies of manufacturing and analysis

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4, PO7/PSO1, PSO2
CO2	PO1,PO5, PO6, PO7, PO8/PSO1, PSO2

MSBC 0003: BIOINFORMATICS

OBJECTIVES: To expose students with essential elements of bioinformatics, viz. structural bioinformatics, functional bioinformatics, database searching and scope of various biological databases in life science research.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Biological Databases** Nucleotide databases at NCBI (GenBank, ESTs, SNP, UniGene, STS, RefSeq), File Formats, Access to Information via Entrez Gene at NCBI, Other databases: PubMed, OMIM, Taxonomy Chemical classification of amino acids, Principles of protein structure (Primary, Secondary, Tertiary and Quaternary), dihedral angle (ψ and φ), Ramachandran Plot, Protein database: UniProt), and Taxonomic System for Protein Structure: SCOP, CATH, Structural Databases (PDB, MMDB) **Techniques in Bioinformatics** Sequence Alignment: Global Alignment vs. Local Alignment, Dynamic Programming, and Concept of amino acids scoring matrices in Alignment: Dayhoff PAM matrices, BLOSUM Matrices,	14 18
II	Database similarity searching: BLAST, psi BALST Multiple Sequence Alignment: Star Alignment Heuristics, Applications of MSA: PSSM, Profiles, HMM. **Structural and Functional Bioinformatics** Identification of Protein Motif and Domain using MSA, Motif databases: PROSITE, PRINT, BLOCKS, InterPro, and Protein Tertiary Structure Prediction: homology modeling, Threading & Fold recognition, ab intio, Introduction to Microarray technology (Affymatrix, Agilent, cDNA), Text Mining for information extraction from Biomedical Literature	24

Text Book:

- Bioinformatics: Principles & Application by Zhumur, Ghosh

Reference Books:

- Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science.
- Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.
- Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co.
- Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.
- Purifing Protein for Protemics, Richard J. Sinpson, I.K. International Pvt. Ltd.

COURSE OUTCOMES: The major outcomes of this course are:

CO1- To acquaint fundamental knowledge of bioinformatics tools and techniques and how to effectively utilize these resources in life science research

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO7/PSO1, PSO2

MSMC 0801: GENERAL MICROBIOLOGY & BIOSTATISTICS LAB

COURSE OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Microbiology that they have taught in the theory and provide hands on training on practical techniques of Microbiology related practical.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Safety rules for working in microbiology lab. • Washing of glassware. • Preparation of culture media. • Isolation of bacteria from soil, air and water. • Enumeration of bacterial colonies by serial dilution and plating. • Simple and differential staining. • Special staining technique. • Determination of antibiotic sensitivity test • Cultivation of moulds and other fungi..	30

COURSE OUTCOMES: The major outcomes of this course are:

CO1- will able to observe the morphology of bacteria by using different staining techniques and able to culture the bacteria and fungi in –vitro.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2,PO3, PO4, PO5, PO7 /PSO1,PSO2
CO2	PO1,PO4, PO6, PO7,PO8 /PSO1, PSO2
CO3	PO1,PO3, PO4, PO5, PO8 /PSO1

MSMC 0802: BIOCHEMISTRY & BIOPHYSICAL TECHNIQUES LAB

COURSE OBJECTIVES: Biophysical techniques form the basis for all aspects of modern Biotechnology. The objective of the course is to advance the student's knowledge of spectroscopic, electrophoresis, chromatographic techniques and other current biophysical methods.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To carry out preparation of Buffer: Acetate Buffer • To carry out qualitative analysis of Carbohydrates • To carry out qualitative analysis of Lipids • To carry out qualitative analysis of amino acids • To carry out qualitative analysis of Proteins • Determination of Blood Group • To carry out estimation of carbohydrate by Anthrone method • To carry out estimation of DNA by Diphenylamine method • To carry out estimation of RNA by Orcinol method • To carry out estimation of protein by Biuret method • To carry out estimation of protein by Folin- Lowry's method • To carry out estimation of cholesterol in blood serum • To describe the different parts of compound microscope with their fuction. • Separation of lymphocytes by density gradient centrifugation. • To carry out separation of amino acid by Paper Chromatography & determination of Rf value • TLC of fatty acids/lipids • Separation of proteins by PAGE, SDS- PAGE • Agarose gel electrophoresis of nucleic acids • Immunoelectrophoresis, Agar gel diffusion, counter immuno electrophoresis. • Verification of Beer Lambert law with the U.V. spectrophotometer.	30

COURSE OUTCOMES: The major outcomes of this course are:

CO1- To understand fundamental concept of instrumentation
CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid
CO3- To understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO2, PO4, PO5, PO7, PO8 /PSO2, PSO3
CO2	PO1,PO2, PO3, PO6, PO8/PSO1, PSO2
CO3	PO1, PO3, PO6, PO7/PSO1, PSO3

MSBC 0802: BIOINFORMATICS LAB

OBJECTIVES:

Practical are designed to inculcate skill-sets in students to navigate biological databases and utilize bioinformatics software and ascertain them computational possibilities in biotechnology/microbiology.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Database searching against a query sequence and selection of orthologous sequences • using BLAST • Multiple Sequence Alignment using Clustal W • Prediction of Open Reading Frames using ORF Finder • 3 Dimensional Structure of protein using Deep View • Phylogenetic Analysis using Phylip (Neighbor Joining and Maximum Likelihood) • Bio programming using Practical Extraction and Reporting Language (PERL)	15

COURSE OUTCOME: The major outcomes of this course are:

CO1- Students will be able to use tools and techniques of bioinformatics effectively.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO4, PO5, PO7, PO8 /PSO2, PSO3

MSMC 0002: SYSTEMIC BACTERIOLOGY & MYCOLOGY

COURSE OBJECTIVES: To study about the microorganisms associated with infectious diseases, including the bacteria, fungi, and protozoa's. Emphasizes the health care aspects and the distribution and activities of microbes as related to the following: microbial nutrition and anatomy, growth, disease, epidemiology, infection and immunity.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Pathogenesis of bacterial pathogens- Identification of disease causing bacteria, transmission of bacterial infection, innfectious process, genomics and bacterial pathogenecity, bacterial virulence factors, regulation of bacterial virulence factors, Immune response to bacterial infections. Norormal Human Microbiota and Its Role- Normal microbiota of the skin, normal microbiota of the mouth and upper respiratory tract, normal microbiota of the intestinal tract, normal microbiota of urethra, normal microbiota of vagina, normal microbiota of conjuctiva. Morphology, cultural and biochemical characteristics, virulence factors, antigenic structure, patogenesis laboratory diagnosis and prophylaxis of important bacterial pathogens - Staphylococcus, Streptococcus, Escherichia coli, Salmonella, Shigella, Pseudomonas, Vibrio, Corynibacterium, Bordetella, Bacillus, Clostridium, Listeria, Yersenia, Tryponema, Helicobacter, Mycoplasmsma, Chlamydia Leptospira.	18
II	Classification of fungal diseases, General introduction, morphology, pathogenesis, laboratory diagnosis and treatment of *Dermatophytes, Aspergellosis, Candidosis, Chromoblastomycosis, Cryptococosis, Blasomycosis and Coccidiodomycosis.* Immune response to fungal infections. General introduction, morphology, pathogenesis, laboratory diagnosis and treatment of *Girardia lamblia, Entamoeba histolytica, Cryptosporidium, Plasmodium and Toxoplasma.* Immune response to protozoal infections.	24

Text Book:

- R. Ananthanarayan and C. K. Jayaram Paniker, "Textbook of Microbiology", Universities Press (India) Pvt. Ltd. Eleventh edition, 2020.
- W. W. C. Topley, Sir Graham S. Wilson, M.T. Parker, L.H. Collier, "Text book on principles of bacteriology, virology and immunology": IX edition (5 volumes), Edward, London, 1995.

Reference Books:

- G. J. Tortora and B. R. Funke and C. L Case, "Microbiology: An Introduction" Pearson Publication, 11 Edition, 2016.

OUTCOME: The major outcome of this course are-

CO1- This course helps to demonstrate and evaluate the interactions between microbes and humans and factors that may contribute to disease.

CO2- Identify and evaluate microbial diseases: their causative agent, source (or vector), reservoir, epidemiology, mode of transmission.

CO3-Identify and evaluate microbial diseases: their pathogenesis, symptoms, diagnosis, prevention, control, treatment, and applicable clinical isolation precautions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO7, PO8 /PSO2, PSO3
CO2	PO2,PO4, PO5, PO7 /PSO1, PSO4
CO3	PO1,PO2, PO5, PO6, PO8 /PSO1, PSO2, PSO4

MSMC 0003: SYSTEMIC VIROLOGY

COURSE OBJECTIVES: The course is aimed to make bio students aware about importance of viruses in field of medicine, molecular biology and cancer.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Over view of Virology: Reasons for studying virology, Disease causing agents in humans animals plants. Usefulness of viruses Contributions of virus in molecular biology, cell biology and cancer. viroids and prions, Methods used in virology Isolation and cultivation of virus, centrifugation, Microscopy, X-Ray crystallography and electrophoretic techniques detection of viruses and viral components electron microscopy Detection of infectivity using cell culture Detection of virus antigen Detection of virus nucleic acids: Hybridization, PCR Criteria of classification and classification of viruses, pathogenesis modes of Transmission Antiviral agents. Brief Account of morphology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis of RNA virus families- Picornaviridae (Polio virus), Reoviridae (Reovirus and Rotavirus), Togaviridae (Yellow fever virus), Orthomyxoviridae (Influenza virus), Paramymyxoviridae (mumps, measles & Rubella virus), coronaviridae (Coronavirus), Rhabdoviridae (Rabies virus), and Retroviridae (AIDS & Lenti virus), Bunyaviridae and Hepatitis virus.	18
II	Infectivity Assays- Quantitative assays, Quantal assays one step growth, Virus Genetics Brief Account of morphology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis of DNA virus families- Parvoviridae (Parvovirus), Adenoviridae (Adenovirus), Herpesviridae (Herpes simplex virus and vercilla zoster virus), Poxviridae (Poxvirus) and Hepadnaviridae (Hepatitis-B virus). Plant Viruses: Methods of Assay of Plant Viruses, Biology and Mode of Trnasmission of Plant Viruses, Discussion on some of the Important Plant Diseases Caused by Viruses and their Control: Tobacco Mosaic Virus (TMV - Symptoms, Viral Structure Protein Synthesis, Transmission); Potyvirus Group (Potato Virus Y), Cauliflower Mosaic Virus.	24

Text Book:

- Text book on principles of bacteriology, virology and immunology, IX edition (5 volumes), Edward, London by Topley and Wilson.

Reference Books:

- Microbiology: Davis, B. D.; Delbecco, R.; Eisen, H.N.; Ginsberg, H.S., by Haper & Row.
- Medical Microbiology : Greenwood, D, Slack, R. C. B., Pleutherer, 1. F., Churchill Livingstone.
- Virology : Principles and applications, John B. Carter and Venetia A. Saunders WILEY
- Animal Virology: Frank and Fennar

OUTCOME: The major outcome of this course are-

CO1- To generate manpower through post graduate level teaching program on novel approaches to tackle major communicable and emerging diseases problems at national and global level.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2, PSO3, PSO4

MSBC 0005: IMMUNOLOGY

OBJECTIVES: To learn about the structural and functional features of the components of the immune system and emphasis will be on the mechanisms involved in immune system, development and responsiveness.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Overview and importance of Immunology. • Cells and organs involved in immune system. • B cell development. • T cell development • Molecules communicating among cells of immune system their receptors & signaling. • **Innate immunity (Nonspecific defense mechanism) –**Definition, Ubiquity, Innate defensive barriers, (Anatomical, Physiochemical and cellular) phgocytosis and inflammation, Generation of anti microbial mechanisms, Receptors (TLR, Scavenge receptor etc.) of the innate immunity, Signal transduction pathways in activation of innate immunity, Link between Innate and adaptive immunity. • **Adaptive immunity (Specific defense mechanism)-** Definition, Types of adaptive immunity, Attributes, Antigen (Immunogen) Haptens Definition, properties and types, Factors affecting antigencity, Epitopes recognized by B and T lymphocytes, Adjuvants, examples and mechanisms in enhancing antigenecity. • **Immunoglobulins-** Definition, Basic structure, classes and subclasses, Physico-chemical and biological properties, Antigenic determinants on immunoglobulins, Functions of Fab and FC portion of ig : Enhancement of phagocytasis (opsonization), Activation of complement, Killing of target cell by ADCC, Transcytosis, Chemical vignette, Monoclonal and genetically engineered antibodies. Organisation of immunoglobulin genes, Mechanisms for generating regulation of Antibody Diversity. • Class switching. • Immunoglobulin gene super family.	18

II	• Antigen - Antibody interactions, General properties of Ag-Ab interaction, Importance in host and in laboratory, Principles and applications of in invitro Ag.Ab interactions, Different types of serological tests (Precipitation, Agglutination, CFT, Immunofluorescence, RIA, ELISA, Flowcytometry). • **The major histocompatibility complex (MHC)-** Structure and functions of MHC molecules, Organisation of MHC genes & MHC molecules, expression patterns, The endogenous pathway of antigen processing and presentation, The Exogenous pathway of antigen processing and presentation, Self –MHC restriction, Presentation of non peptide antigen. • **Immunomediated disorders-** • **Hypersensitivity and Allergy –** Definition, Classification, Distinguishing Features of Immediate and Delayed Hypersensitivity, IgE Mediated Hypersensitivity (Type I), Method used for Detection, Anaphylactic Reaction. Antibody Mediated Cytotoxicity (Type II) Hyper Sensitivity, Mechanism and Examples, Immune Complex (Type III) Hypersensitivity: Localized and Generalized Type III Reactions, Mechanism, Anybody Mediated Cell Stimulation (Type V) Hypersensitivity. Mechanism, Delayed (Type IV) Hypersensitivity Mechanism and Important Aspect in Diagnosis of Diseases • **Immuno Tolerance, Auto Immunity and immuno deficiency.** • **Vaccines and Toxoids** o Inactivated and Live Attenuated Vaccines o Sub unit Vaccines (synthetic & recombinant) o Conjugate Vaccines, multi component vaccine o Recombinant Vector Vaccines o DNA Vaccines o Toxoids.	24

Text Book:

Immunology by Shetty, N

Reference Books:

- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)
- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima

COURSE OUTCOMES: The major outcomes of this course are:

CO1- To understand the ability of our defense mechanism to protect against invanding pathogens in logical fashion.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2

MSBC 0006: GENETICS & MOLECULAR BIOLOGY

OBJECTIVES: Biomolecules are important constituents of organism, Molecular biology provides the knowledge of DNA , RNA and Proteins for the organization of life and their function in different vital concept of life.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Basics of genetics • Organization of Prokaryotic and Eukaryotic Genome. • DNA Replication machinery in Prokaryotes and Eukaryotes . Regulation of DNA replication. • DNA repair mechanism. • Transcription in prokaryotes and Eukaryotes, Reverse transcription. • RNA processing, and editing. Regulation of gene expression in prokaryotes: • Regulation of gene expression in eukaryotes: Activators, and Insulators, Chromatin Remodeling, Chemical Modifications of Histones: role of Histone Acetyl transferases, and Deacetylases, Signal Transduction and control of transcriptional regulation, microRNAs and their role in gene expression regulation • Genetic Code: Evidence and properties; Wobble hypothesis; Transcriptional adaptors and amino acyl tRNA synthases	18
II	• Translation: Successive stages of protein synthesis in prokaryotes and eukaryotes • Protein degradation via proteasomes • Post-translational Modification: Types and Significance • Genetic recombination in prokaryotes and eukaryotes and its molecular mechanism. • Transposable elements in Prokaryotes and Eukaryotes: Types and Significance • Chromosomal and gene mutation • Introduction and application of Molecular markers (RFLP,AFLP.RAPD,SNP, and VNTR) • Biomedical Genetics & its application • Modern molecular Diagnostic techniques.	24

Text Book:

- Cell Biology, Genetics, Molecular Biology by Verma, P.S
- Molecular Biology by Friefelder, David

Reference Books:

- Albert B, Bray Denis et al.: Molecular Biology of The Cell.
- Watson, Hopkin, Roberts et al.: Molecular Biology of the Gene.
- Genetics- Strickberger.
- Microbial Genetics – D. Frifielder.
- Baltimore- Molecular Biology of the Cell.
- Benjamin Levin – Genes VIII.
- Advance Genetics by G.S. Miglani, Narosa Publishing House.

OUTCOME: The major outcomes of this course are:

CO1- To provide the different concept of expression of genetic molecule DNA ,RNA and proteins and their association with the genetic and physiological variation of higher and lower organism and how they are associated with each other and how their character inherited from generation to generation.

CO2- It was also learned how the Molecular biology is important in forensic science.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1, PO2, PO4, PO5, PO7, PO8 /PSO3, PSO4

BELH 0012: INTRODUCTION TO GENDER & WOMEN'S STUDIES

OBJECTIVES: An introductory course designed to introduce students to a variety of issues and disciplinary approaches to the study of women and gender. Classes will use audio-visual methods with oral presentations by students. Emphasis is given to the English language skills for oral communication and writing. Compulsory attendance. Limited enrolment for supervised learning.

EXPANDED DESCRIPTION: The question of gender is often a vexing one that has been important in shaping human experience and culture. We will explore how gender intersects with class, ethnicity, religion, age and other categories of experience. This course will focus primarily on gender and women's issues in the modern world. In addition to assigned readings from a range of texts, we will also attempt to examine representations of women and their condition in film and other media.

Themes: With a focus on issues of gender in domestic and workplace situations, the course will use the reading selections and multimedia materials to address a wide range of topical categories and themes, which will also be the base of students' Oral/Group Presentations:

Credits: 2 **Semester: II** **L-T-P: 2-0-0**

Module	Content	Teaching Hours
I	**Introduction** Becoming a Man or Woman: Emotions, Love, Beauty and the Media Women, Men & Sexuality: Gender & Human Bodies Modernity and Power: Institutions that Shape Our Lives Violence against Women: Domestic & Work Spaces Women and Violence: War and Terrorism	**12**
II	Health & Reproductive Freedom: Mothering and Parenting Differences among Us: Ageism, Racism and Prejudice **Review** Changing Our World: Culture, Society & Practice of Gender Sensitization Oral Presentations by Students	**18**

Recommended Reading:All materials will be available via email or online LMS (there are no course textbooks to purchase). Students will require access tothe internet and a computer.

Audio-Visual Material:Audio recordings will be made available via CDs and online.

References: Study-pack derived from *Women: images and realities. A multicultural anthology*. 4th edition. Edited by Amy Kesselman, Lily D. McNair, Nancy Schniedewind. McGraw-Hill, 2007.

Course Outcomes: After completion of the course, students will be able to:

CO1- Identify important terms and concepts in the field of gender studies
CO2- Discuss the significance of important work done in this field
CO3- Discuss how different factors like age, ethnicity, race and culture impact human experiences
CO4- Discuss how women's studies and gender sensitization have led to revisions of cultural assumptions and practices regarding women
CO5- Relate gender concepts to our lived experiences
CO6- Be able to develop an oral presentation on a proposed project in some area of gender sensitization

Value Addition: Students will be able to connect, write and speak with confidence and clarity about their own responses to the selected readings and about gender and women's issues from multiple perspectives.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO4, PO7, PO8 /PSO1, PSO2, PO4
CO2	PO2, po3, PO4, PO5, PO7, PO8 /PSO1, PSO3
CO3	PO2, PO8 /PSO1, PSO2
CO4	PO1, PO2, PO8 /PSO2, PSO3
CO5	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO6	PO2, PO5, PO7, /PSO1, PSO2, PSO3

MSMC 0803: BACTERIOLOGY & MYCOLOGY LAB

COURSE OBJECTIVES:

The objective of this course is to well verse the students with practical knowledge of Bacteriology & Mycology that they have taught in the theory and provide hands on training on practical techniques of Bacteriology & Mycology related practical.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Safety guide lines follow in Bacteriology laboratory. • To study the morphology of bacteria. • To study the cultural characteristics of bacteria. • To Demonstrate the fermentation of different carbohydrate by bacteria. • To perform IMVIC test for the identification of bacteria. • Isolation of fungi from soil sample. • To identify the fungi by staining process. • Calibration and standardization of microscope by using ocular micrometer and stage micrometer. • Primary isolation of enteric pathogens *E. coli*, *Salmonella* and *Shigella*.. • Confermation of enteric pathogens *(E. coli*, *Salmonella* and *shigella)* by biochemical test. • Isolation and identification of bacteria from clinical specimens and their antibiogram.	30

COURSE OUTCOME: The major outcomes of this course are:

CO1- Student will be able to handle the laboratory animals.

CO2- In addition to this, different antigen antibody reactions will be performed by the student with isolation and identification of different kinds of bacteria with conceptual understanding of the subject.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1, PO2, PO4, PO5, PO7, PO8 /PSO1, PSO3, PSO4

MSBC 0805: IMMUNOLOGY LAB

COURSE OBJECTIVES:

The objective of this course is to well verse the students with practical knowledge of Bacteriology & Mycology that they have taught in the theory and provide hands on training on practical techniques of Bacteriology & Mycology related practical.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours

I	• Handling of laboratory animals.
	• Routes of inoculation in lab animals.
	• Gel diffusion test-
	  ○ Redial diffusion test.
	  ○ Ouchterlany diffurion test.
	  ○ Rocket electrophoresis.
	  ○ Immuno electrophoresis.
	• Slide agglutination test.
	• Tube agglutination test / Passive agglutination.
	• ELISA Test.
		30

COURSE OUTCOMES: The major outcomes of this course are:

CO1- Student will be able to handle the laboratory animals.

CO2- In addition to this, different antigen antibody reactions will be performed by the student with isolation and identification of different kinds of bacteria with conceptual understanding of the subject.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1, PO2, PO4, PO6, PO7, PO8 /PSO1, PSO3, PSO4

0804: GENETICS, MOLECULAR BIOLOGY AND VIROLOGY LAB

COURSE OBJECTIVE:

The objective of this course is well verse the students with the practical knowledge of genetics, molecular biology and virology that they have taught in theory and practical and provides hands on training.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours

I	• Estimation of DNA content in the given sample by diphenylamine method.
	• (Nitrogen cylinders, -200C fridge, grinders, cooling centrifuges, etc.)
	• Estimation of RNA content by the Orcinol method.
	• Determination of Tm of DNA and RNA.
	• Isolation of Plasmid DNA.
	• Isolation of bacterial/fungal genomic DNA.
	• Isolation of plant DNA.
	• Purification of DNA through columns.
	• Restriction mapping of the DNA isolated from plant, bacteria and fungi.
	• Transformation of the bacterial cell.
	• PAGE OR Agarose gel electrophoresis of DNA
	• Cloning of genes in eukaryotic and prokaryotic vectors.
	• Haemagglutination test.
	• Haemagglutination inhibition test.
	• ELISA Test-
	  ○ Indirect ELISA.
	  ○ Sandwich ELISA.
	  ○ Competetive ELISA.
	  ○ ELISA Test.
	  ○ Neutralization Test.
		30

COURSE OUTCOMES: After completion of module student will be able-

CO1- To perform different molecular techniques for isolation of DNA, RNA etc.
CO2- In addition to these students will be able to perform various methods for demonstration and handling of virus.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4 PO5, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1, PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2, PSO4

MSMC 0004: FERMENTATION TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

COURSE OBJECTIVES: The objective of the course is to help students attain a basic proficiency, role and application of biotechnology in the area of food and industrial processes.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Bioreactors: Principle, Kinetics, types, design, analysis and application.Types of fermentation processes: analysis of batch, Fed-batch and continuous Bioreactions, stability of microbial reactions. Aeration and Agitation systems for bioreactor.Flow behavior of fermentation fluids Gas-Liquid mass transfer, Solid and Liquid-phase mass transfer and Heat transfer. Measurement and control of bioprocess parameters. Production of Alcohols and Organic Acid : Alcohol Production - Malt-Beverages, Production of Beer, Production of Wines, Distilled Beverages or Liquors (Rum, Whiskeys, Brandy), Vinegar Production, Organic Acids - Citric, Lactic, Acetic, Propionic.	18
II	Production of Enzymes: Extracellular - Amylase.Protesases, Pectinases, Lipase, Cellulases, X ylanases, and Intracellular - Glucose Isomerase. Downstream processing, Immobilization of cell and Enzyme and their application. Vitamins - Vit B 12 and Riboflavin. Amino acids - Glutamic acid and Lysine. Production of Antibiotics : Antibiotics - β- Lactam (Penicillin and Cephalosporin), and Tetracyclines, Steptomycin, Polyenes (Nystatin), Aromatic (Griseofulvin). Microbial Transformations of Steroids or Sterols, Nonsteroid Compounds and Antibiotics. Single Cell Protein, Polysaccharides, Recombinant DNA Products Insulin, Somatostatin and Interferon.	24

Text Book:

- Biotechnology by Singh, B.D

Reference Books:

- Bioprocess Engineering by P.K. Ghosh
- Fermentation Microbiology and Biotechnology by EL-Mansi & C.F.A.Bryce eds
- Manual of Industrial Microbiology and Biotechnology By Demain & Davies
- Principles of Fermentation Technology Stanbury, Whittaker & Hall

- Industrial Microbiology by Prescott & Dunn
- Microbial Biotechnology by Glazer & Nikaido
- A Text Book of Industrial Microbiology by Cruger and Cruger
- Manual of Industrial Microbiology & Biotechnology, Arnold et al

COURSE OUTCOMES: After completion of this course student will be able to

CO1- Understand contribution of microbes in food industry.

CO2- Positive and negative impact of various microbes in terms of "fermentation, microbial metabolism" and "principles underlying food spoilage and contamination, various food borne infections and intoxications" respectively.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO5, PO6/ PSO2, PSO3, PSO4

MSMC 0005: FOOD, DAIRY AND AGRICULTURAL MICROBIOLOGY

COURSE OBJECTIVES: This course designed to introduce the essential fundamentals of Agriculture Microbiology. This course focuses on the concepts of Agricultural Microbiology such as Soil Environment, bacteria and viruses, bio pesticides & bio fertilizers and plant microbe-interactions. The Food Microbiology paper would enable students to learn about the epidemiology of food-borne diseases and the pathogens. Also, the study would equip them to study various methods of pathogen detection available along with understanding the beneficial and harmful effects of microbes in the food industry.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Food Spoilage: Spoilage of Cereals and Cereal Products, Fruits and Vegetables, Meat and Meat Products, Poultry and Eggs, Fish and Other Sea Foods, Milk and Milk Products, Beers and Wines, Fermented Foods and Canned Foods. Food Preservation: General Principal of Food Preservation, Aspesis, Removal, Anearobic Conditions, Low and High Temperature (pasturization, Sterilisation and Ultra High Temperature Treatment), and Drying./ Chemical Preservation of Food - Organic Acids and Their Salts, Propionates, Benzoate, Sorbate and Acetate, Nitrate, Nitrite, Sulphur Dioxide, Sulphides, Ethylene and Propiolene Oxides,Sugar and Salt, Alcohol. Benzoic Acid, Spices and Condiments. Preservation by Radiation. Fermented Food: Manufacture of Fermented Foods Like Dairy Products (Acidophilus Milk, Cheeses, Yoghurt, Kefir, Kumiss), Plant Product (Cocoa Beans, Coffee Beans, Pickels, Saur-kraut) Breads and Vineger.	18
II	Food Borne Diseases: Cholera, Stapylococcal Food Poisoning, Bacillus cereus Gastroenteritis, Botulism, Salmonellosis, Shigellosis, Typhoid Fever, Hepatitis-A, Poliomyelitis.Microbial Interaction: Ecological groups of microorganisms- Aututrophs and Heterotrophs; Psychrophiles, Mesophiles, Thermophiles, Hyperthermophiles. Soil Microorganisms, Aquatic Microorganisms, Air Microorganisms. Saprophytism, Parasitism, and Symbiosis. Antagonistic Interaction- Amensalism, Competition and Predation. Rhizosphere and Rhizoplane Microorganisms- Reasons for increased Microbial Activity in Rhizosphere, Composition of Root Exudates, Rhizosphere Microorganisms. Nitrogen Fixation (Symbiotic and Non Symbiotic), Node and Nodulins, Nitrogenase Enzyme, Nif Genes, Biofertilizers and microbial inoculants.	24

Text Books:

- Food Microbiology: Frazier, W. C. And Westhoff, D.C., Tata McGraw Hill Pvt. Co. Ltd.

Reference Books:

- Food Microbiology: James, J, CBS Publisher & Distributor, New Delhi. Comprehensive Dairy Microbiology: Yadav, J S., Grover, S. & Batish, V. K., S. Chand & Co., New Delhi
- Food Microbiology: ,Adams, M. R. And Moss, M. 0., New Age International (P) Ltd. Publishers, New Delhi.
- Soil Microorganisms & plant Growth: Subbarao, N. S., Oxford & IBH Publishing Co. Pvt. Ltd., New

COURSE OUTCOMES: After completion of this course student will be able to

CO1- Understand industrial application of microorganisms and recent microbial products.

CO2- Students will know the applied and industrial aspects of microbiology such as screening of microorganisms, strain improvement, microbial metabolites, fermented microbial products and microbial enzymes. The recent applications of the microbes for the human welfare are well structured in this paper.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO4
CO2	PO1,PO2 PO3, PO4, PO5, PO6/ PSO2, PSO3, PSO4

MSBC 0011: RDT, GENOMICS & PROTEOMICS

COURSE OBJECTIVES: To expose students with recent advances in the field of Recombinant DNA Technology, and Genomics & Proteomics and their implication in life sciences research.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Tools used in GE** Principles of Gene Cloning, Enzymes used in RDT: Restriction Endonuclases, restriction digestion and restriction mapping, other DNA Manipulative enzymes, linkers and adaptors, Blunt end ligation Cloning vectors for E. coli: pBR322, pUC19, pGEM3Z, M13, Phagemids, Phage λ, Cosmid and BAC; Expression cassette, Transcriptional and Translational Fusion, limitations of recombinant protein production in prokaryotic host, Shuttle Vector, Cloning vectors for yeast : comparison of YEp, YIp and YRp, YAC **Techniques in GE** Gene and cDNA library, Molecular Probes, methods for clone identification: colony and plaque hybridization probing, Immunological detection methods, Polymerase Chain Reaction, PCR Primer designing, qPCR, site directed mutagenesis,	18
II	DNA Sequencing, Pyrosequencing, Sequencing by Synthesis (SBS) by Illumina, SOLiD™ **Genomics & Proteomics** Genome sequencing: Shot Gun, Clone Contig, Contig assembly by chromosomal walking, sequence tagged site; Genetic and Physical Mapping, Importance of map in sequence assembly Genome Annotation: identifying genes in a genome sequence, determining the function of an unknown gene Studying the transcriptome: Serial Analysis of gene Expression, Microarray Studying the Proteome: separation of proteins using 2D Gel, identification of individual protein using MALDI-TOF Studying protein-protein interactions: phage display, the yeast two hybrid system.	24

Text Book:

- Genetic Engineering by Rastogi, Samita

Reference Books:

- "Principles of Gene Manipulation" by R.W. Old and S.B. Primrose Third Edition Blackwell Scientific Publication
- "Gene Cloning " by T.A.Brown
- Molecular Biotechnology by Glick
- Expanding Horizons by B.D.Singh

COURSE OUTCOMES: After completion of the course, students will be able:

CO1- To acquaint theoretical understanding of genetic engineering tools and techniques, i.e. restriction digestion, blotting, map-based cloning, PCR etc.

CO2-To learn how to exploit various ~omics technologies in biotechnology related activities

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1, PO3, PO4, PO5, PO6/PSO1, PSO2, PSO3

MSMC 0006: ADVANCED IMMUNOLOGY

COURSE OBJECTIVES: Understand the molecular and cellular basis of the immune system and integrate this knowledge into a framework by which to understand host defense to infection and microbial immune evasion strategies.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Transplantation Immunology:** • Graft rejection and immunologic principles • Specificity and memory in graft rejection • Transplantation Mltc antigens and blood groups • Clinical course during clinical course • Approaches to induce transplantation tolerance • Immune Responses to infections diseases (Bacteria, Fungal, viruses and protozoans). **Cancer Immunology:** • Terminology and types of cancer • Differences between normal and malignant cell • Malignant transformation of cell **Cancer associated genes:** Cancer promoting activity of oncogens, the relationship of proto-oncogens to oncogens, Cancer suppressor genes and Role of Apoptotic genes in cancer **Tumor antigens:** Tumor specific antigens, Tumor associated antigens	18
II	**Immune responses to cancer:** Immuno Surveillance, Immuno editing **Immuno eradication of cancer:** Innate and adaptive cells involved in cancer eradication, Antitumor Antibodies, role of cytokines **Cancer promoting immune reaction:** Inflammating responses, Anti tumor antibodies, Immunosuppression in tumor micro environment, Immuno evasion **Cancer immunotherapy:** • Cytokine based therapy • Monoclonal antibodies based therapy • Immunology in detection of cancer. **Vaccinology:** • Concept & scope and limitations of vaccines Evaluation of vaccines • Principles of vaccine Design and development • Strategies to vaccine design for stimulating innate immunity and mucosal immune system. • Selection of models in vaccine design • Sequence- Based computational approaches to vaccine discovery and design: Introduction, Designing vaccines based on	24

	alignments, Designing vaccines using epitope prediction • Antigen discovery for vaccines using high throughput proteomic screening technologies: Introduction, Synthetic proteomes, HT antibody screening, T-cell screening platforms, Strategies for identification of protective antigens, Future challenges.	

Text Book:

- Immunology by Shetty, N

Reference Books:

- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)
- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima

OUTCOME: After completion of the course, students will be able:

CO1- This will also attempt to bring students up to date with current areas of basics research in immunology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2, PSO4

MSMO 0001: ENVIRONMENTAL MICROBIOLOGY

COURSE OBJECTIVES: One of the main objectives of study is the treatment and management of waste. In addition, concept, significance and application of micro-organisms for environmental cleaning.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Concept and significance of environmental microbiology. Microorganisms and Environment- Microbial diversity in normal environments, terrestrial (agricultural and desert soils), aquatic (fresh water and marine), atmospheric (stratosphere) and their potential applications. Microbes in extreme environment and their adaptation. Nutrient cycling process, carbon cycle, nitrogen cycle, sulphur cycle. Environmental Pollution and types. Role of microbes for safe and sustainable environment. Biodegradation and Biodeterioration, their economical impact. Liquid waste management: Treatment of sewage (Primary, Secondary and Tertiary treatments) and Treatment of Industrial effluents (distillery, textile, pulp and paper). Solid waste management: Waste types & their possible usages, landfill development and composting.	18
II	Bioremediation of environmental pollutants: Petroleum hydrocarbons and pesticides. Microbes and mineral recovery: Bioleaching of copper, gold and uranium. Desulphrisation of coal.Lignin degradation: Lignocellulolytic microorganisms, enzymes and their biotechnological applications. Biofertilizers- Nitrogen fixing and phosphate solubilizing biofertilizers. Microbial Insecticides- Bacterial, fungal and viral insecticides. Advances in Applied Bioremediation, their significant and applications for solving environmental pollution problems.	24

Text Book:

- Biotechnology . B.D.Singh.
- Microbiology. P.D. Sharma.

Reference Books:

- Waste water treatment for pollution control. Arceivala.
- Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P. Gerba
- Comprehensive Biotechnology Vol. – 4. Murray Moo Young.
- Biotechnology. Rehm and Reid.
- Environmental chemistry. A.K.De, Wiley Eastern Ltd., New Delhi.
- Introduction to Biodeterioration. D.Allsopp and Seal, ELBS/ Edward Arnold.
- Environmental Biotechnologies and Cleaner Bioprocess by Eugenia J Olguuin et al.

- Environmental Science: Physical Principles and applications by Egbert Booker et al

OUTCOME: After completion of module student will be able to –

CO1- Understand contribution of microbes in environmental cleaning, microbial diversity, environmental pollution and types.

CO2-In addition the concept of advances in applied bioremediation, their significant and applications for solving environmental pollution.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1, PO4, PO5, PO7, PO8 /PSO1, PSO3, PSO4

MSBO 0001: NANOBIOTECHNOLOGY

COURSE OBJECTIVES:

- The mission of the Nanobiotechnology Program is to provide a multidisciplinary education in nanoscale science and technology. The primary goals are:
- Prepare students for a career in nanotechnology by providing them with a sound grounding in multidisciplinary areas of nanoscale science and engineering.
- Increase students' understanding of materials and their properties.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, Biological production of metal nano particles, macro molecular assemblies, quantum dots technology and its application, Application in Biomedical and biological research, tumor targeting and other diagnostic applications.	12
II	viruses as nano-particles ,nano chemicals and application, Developing drug delivery tools through nano biotechnology, nano particle based immobilization assays. Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic, orthopedic areas. Biosensors and nano biotechnology principles used in construction of micro electronic devices ,sensors and macro mechanical structures and their functioning, immuno-nanotechnology	12

Text Book:

1. Subbaih Balaji, “Nano Biotechnology”: MJP Publishers, 2010

Reference Books:

1. Christof M. Niemeyer , Chad A. Mirkin, “Nanobiotechnology - concepts, applications and perspectives”: wiley publishers,2004.
2. Donald Martin,”Nanobiotechnology of biomimetic membranes”: springer verlag publishers, 2007.

OUTCOME: After completion of course, the student will be able to:

CO1- The necessary foundation for training in research.
CO2- Provide theoretical and practical knowledge related to modern nanotechnology.
CO3- On completing master's degree, should be capable of reflecting on central, ethical and scientific problems related to nanobiotechnology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2 PSO4
CO2	PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2, PSO3

MSBO 0002: ENZYME TECHNOLOGY

OBJECTIVES: The course will provide an overview of the key enzymes currently used in large scale industrial processes. An overview of industrial scale protein production will be presented, including an introduction to applicable microbial expression hosts, downstream processing & purification methods, and enzyme optimization through enzyme discovery and engineering.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• History and introduction to enzymes : Classification of enzymes. IUPAC system, nomenclature, E.C. numbers. • Enzyme kinetics (Michaelis – Menten laws), importance and determination of V and K values, Hofstee's plot, L & B plots. • Bisubstrate reactions-ordered & random sequential mechanism. Theorell chance mechanism, ping pong mechanism, products of inhibition in bisubstaect reactions. • Enzyme inhibition: competitive, non-competitive and other types. • Extraction of soluble and membrane bound enzymes from microbial, plant and animal tissues. • Purification of enzymes : salt precipitation, gel fitration, ion exchange and affinity cromatography. • allosteric enzymes. • Multienzyme complexes. • Methods of storing enzymes.	10
II	• Regulation of enzyme activity, various controls (metabolic compartmentation, covalent modifications and others), feedback regulation • Mechanism of Enzyme catalysis: acid-base catalysis, substrate strain, covalent catalysis and entropy effects • Large scale production of enzymes including genetic engineering approaches for their over production. • Enzyme engineering; identification of active sites, approaches for modification of catalytic properties. • Techniques of enzyme immobilization and applications of enzymes in : Food industry – High fructose syrup, cheese making and beer industry. Antibiotics and other Pharamaceuticals Medical applications Analysis of substances, enzyme electrodes,enzyme thermistors.	14

Text Book:

- S. Shanmugam, T. Satishkumar and M. Shanmugaprakash, "Enzyme Technology" : I.K. International, 2012

Reference Books:

- T. Palmer, "Understanding Enzymes" : John Wiley & Sons, 1981
- N.C. Price and L. Stevens, "Fundamentals of Enzymology" : Oxford University Press, 1982
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Course Outcome: The major outcomes of this course are:

CO1- To explain the key structural and energetic factors which give rise to increased enzyme stability important for industrial application, summarize current processes involved in industrial enzyme production, from protein production to purification and formulation,

CO2- To compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO4, PO5, PO8 /PSO2, PSO4
CO2	PO1,PO3, PO5, PO6, PO8 /PSO2, PSO4

MSBE 0103: CLINICAL RESEARCH IN MEDICINAL PLANTS

OBJECTIVES: To understand the medicinal values of plants.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Alternative systems of medicine (ayurveda, siddha, unani etc.), herbal remedies-toxicity and regulations, Ethnobotany and Ethnopharmacology Need of scientific validation as per WHO & national and international agencies, abiotic and biotic factors affecting productivity and quality, morphological examinations, microscopical evaluation	10
II	Development of standardization parameters, Role of plant associated microbiome in medicinal quality, Most commonly used medicinal plants or herbs in Indian context, Indian institutes and libraries for medicinal plant studies, Phytochemical constituents and their analysis, Pharmacological screening of herbal drugs	14

Text Book:

- Quality control of herbal drugs by Dr. Pulok K. Mukhaejee, Horizons Publisher

Reference Books:

- WHO guidelines on quality control of medicinal plants
- Quality control methods for medicinal plant materials by WHO, pub-Geneva, 1998

COURSE OUTCOMES: The major outcomes of this course are:

CO1- To have knowledge of traditional medicine (ayurveda and its role) in treatment of diseases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2

MSMO 0002: ANIMAL CELL CULTURE

COURSE OBJECTIVES: To understand the principles of animal cell culture. As it is required for the growth of the viruses in animal cells to produce the vaccine from it.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction to animal cell culture and its applications. Equipments and materials for animal cell culture technology, Introduction to balanced salt solution and growth medium, Chemical, physical and metabolic functions of different constituents of culture media. Role of serum and other supplements. Primary cell culture: Collection of tissue, enzymatic separation of cells from tissue, mechanical disaggregation of tissue, Cell viability and growth assays, cell counting,	8
II	cell lines: Routine maintenance, subculture of monolayer cells and suspension cells Cryopreservation: Principle of cryopreservation, cell concentration, freezing media, cooling rate, cryo freezers, revival of frozen cells, Scaling up of animal cell culture: Scale up in suspension and monolayer, Applications of animal cell culture: Cell culture derived vaccine, Stem cells technology and its applications.	8

Text Book:

- Animal Tissue Culture by Aruni, A.Wilson
- Biotechnology by Dubey, R.C

Reference Books:

- Culture of Animal Cells by R.I Freshney
- Animal Cell Culture: Practical Approach by John R W Masters
- Animal Cell Culture Techniques by Ed. Martin Clynes
- Methods in Cell Biology Vol. 57, Animal cell culture methods by J.P.Mather and David Barnes
- Animal cell culture & Technology- Basis from background to bench by Taylor & Fracis

OUTCOME: The major outcomes of this course are:

CO1- The student could able to maintain the cell lines and can use them for the growth of viruses

in vaccine production

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6, PO8 /PSO2, PSO3, PSO4

MSBO 0005: NUTRITIONAL BIOCHEMISTRY

COURSE OBJECTIVE:

The fundamental role of the subject is aware the students about the energy and nutrient need of the body. To inculcate in their minds the role of balanced diet, vitamins and essential minerals, amino acids and fatty acids. Imparting knowledge about body basic metabolism and diseases that could arise as a result of malnutrition. Thus laying the foundation towards a healthy and disease free life.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Energy need of the body: Anabolism and Catabolism, Basal metabolic rate (BMR), factor affecting BMR, its calculation and balance diet. Energy value of different food sources. • Protein & carbohydrate malnutrition, Vitamin (Water soluble and fat soluble). Vitamins and minerals deficiency, hypervitaminosis. Hormonal regulation of body metabolism (Thyroid hormone); • Hormones regulating blood glucose (Insulin, Epinephrine and Glucagon). • Different categories of Biochemicals present in food: Carbohydrates, Proteins, Fats and lipids, Essential and non essential amino acids, fatty acids.	10
II	• Basic biochemistry of Carbohydrates, Proteins, fats and lipids, to meet the energy requirement of the body (Glycoslysis, Krebcycle, ETS). • Composition of body fluids, ECF, ICF, etc. • Body homeostasis maintenance, pH maintenance, Basic buffers of the body. Conditions for Acidosis, Alkalosis and ketosis in the body. • Metabolic deficiency and diseases based on Carbohydrates, liver function test, bile pigment metabolism jaundice, renal function test.	14

Text Book:

- J.L. Jain, S. Jain and N. Jain, “Fundamental of Biochemistry”: S. Chand & Company Pvt. Ltd, 2016

Reference Books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, “Biochemistry” : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, “Lehninger Principles of Biochemistry” : W.H. Freeman,

- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Course Outcome: The major outcomes of this course are:

CO1- To enhance the knowledge of student to uptake jobs in health sector particularly as a dietitian in hospitals, sports and assistance to food industries and dairies

CO2- To understand the importance of maintaining a healthy diet and would make them health conscious for prolongevity in their life spa

CO3- Student would find placements in hospitals, sports as dietitians, etc.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO2, PSO3
CO2	PO1,PO2, PO6, PO7, PO8 /PSO1, PSO3
CO3	PO1, PO7, PO8 /PSO2

MSBO 0006: DRUG DISCOVERY AND DEVELOPMENT

Credits: 04 **Semester III** **L–T–P: 4–0–0**

COURSE OBJECTIVES:

To demonstrate an understanding of the importance of strict quality control and regulation in the drug development process, and an awareness of issues associated with the manufacturing of medicines such as good manufacturing practice.

Module No.	Content	Teaching Hours
I	Computer Aided Drug Design, An Over-view of the different approaches used during computer-aided drug design. Structural Determination of the target enzyme, Design of the inhibitor molecules, Collection of the inhibitor molecules, Docking. Process of Drug Discovery: Reductionist target-based approach, Target identification and validation, lead identification: High through-put screening, lead optimization and prioritization: ADME-TOX properties	10
II	Process of Drug Development: considerations and strategies, cost estimates, factors for choosing candidates for drug development, preclinical studies (cell-based and animal studies), clinical studies (Phase 1, 2, 3) New strategies in drug discovery: Structure based drug designing, Molecular docking, Computer aided drug designing, chemi-informatics etc. global dynamics of proteins between structure and functions Biosensors and Devices: Introduction and its applications.	14

OUTCOMES-

Demonstrate an awareness of the important contributions the different discipline areas make to the drug discovery and development process.Demonstrate an awareness of the current approaches to global drug discovery and their advantages and limitations

TEXT BOOK -

• Second edition Bioinformatics, M.M. Ranga

• Principles of Biochemistry, Author: AlbertL. Lehninger, Pub: CBS

REFERENCES BOOK-

• Basic Principles of Drug Discovery and Development by Benjamin Blass

COURSE OUTCOMES: The major outcomes of this course are:

CO1- To demonstrate an awareness of the important contributions the different discipline areas make to the drug discovery and development process.

CO2- To demonstrate an awareness of the current approaches to global drug discovery and their advantages and limitations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2, PSO3

MSBO 0007: IPR, PATENT, TRADEMARKS AND BIOETHICS

Credits: 04 **Semester III** **L–T–P: 4–0–0**

COURSE OBJECTIVES:

Intellectual property rights enlighten the student knowledge towards the development of novel ideas and goods in the field of biotechnology.

Module No.	Content	Teaching Hours
I	**IPR :** Introduction to IPR, History of IPR in India. Essential elements of IPR- Trade secret, Patent, Copyright, Trademark. International harmonization of patent laws – WTO, GATT, TRIPs, WIPO. India and TRIPs, Protection of biotechnological inventions, IPR and developing countries, Broad patents in biotechnology, Choice of IPR protection, Management of IPR , Benefits and problems from IPR, Indian response to IPR upheaval. **Biosafety-** Introduction to Biosafety, Definition and objectives of biosafety guidelines. Risk Assessment- Assessment of risk during laboratory research, Risk Assessment of Biotechnolohy products. Risk regulation. Containment- Physical containment, Biological containment.	10
II	Biosafety guidelines in India, Biosafety Level – BL1, BL2, BL3 and BL4. Research involving plants – BL1-P, BL2-P, BL3-P and BL4-P. Research involving Animals- BL1-N, BL-2N, Bl3-N and BL4-N. **Bioethics-** Bioethics in Biodiversity Resource management – Definition, Ethical issues of biodiversity. Ethical issues in genetically modified organisms- Introduction, History of genetic modification, Techniques of genetic modification, Uses of genetic modification. Genetically modified food, Health implications of genetically modified food, Public health principles regarding the regulation of genetically modified food. Labeling of genetically modified food products. Benefits of labeling, Guidelines for labeling of genetically modified agricultural products. Animal cloning and their ethical aspects.	14

Text Book:

• B.D. Singh. Biotechnology expanding horizons.

Reference Books:

• Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804,9781555811808.
• Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
• Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
• Intellectual property rights-Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
• Intellectual Property Right-Wattal-Oxford Publicatiopn House.(1997)ISBN:0195905024.
• Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic Press.
• H.K.Das. Text book of biotechnology 3rd edition

OUTCOME: The major outcomes of this course are:

CO1- This course will enhance practical applications of students to uptake challenging problems associated with patenting, intellectual property rights in the field of biotechnology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2

MSMC 0805: FERMENTATION TECHNOLOGY, RDT & GENOMICS & PROTEOMICS LAB

Credits: 02 **Semester III** **L–T–P: 0–0–3**

COURSE OBJECTIVES:

To inculcate in students, necessary skill-sets for conducting basic genetic engineering practicals.

Module No.	Content	Lab Hours
I	• Introduction of boifermenter (Assembly and dismenteling) • Production of alcohols in shake flask cultures at laboratory scale. • Production of citric acid in shake flask cultures at laboratory scale. • Production of alpha amylase from Bacillus species. • Isolation of plant DNA. • Purification of DNA through columns. • Restriction mapping of the DNA isolated from plant, bacteria and fungi. • Transformation of the bacterial cell. • PAGE OR Agarose gel electrophoresis of DNA • Cloning of genes in eukaryotic and prokaryotic vectors.	30

OUTCOME: The major outcomes of this course are:

CO1- At the end of course, students will be able to use RDT techniques to design practical biotechnology/microbiology experiments

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4

MSMC 0806: FOOD, DAIRY, AGRICULTURAL MICROBIOLOGY & ADVANCED IMMUNOLOGY LAB

COURSE OBJECTIVES:

The objective of this course is to well verse the students with practical knowledge of Food, Dairy and Agricultural Microbiology that they have taught in the theory and provide hands on training on practical techniques of Food, Dairy and Agricultural Microbiology related practical.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Determination of quality of milk sample using MBRT. • To detect the CFU in milk sample using SPC method. • Enzymatic browning of apples. • Isolation of casein from milk. • To study the effect of salt concentration on microbial growth. • To isolate the B. cereus and Clostridium from food • Isolation of Rhizobia from root nodule. • Isolation of antibiotic resistant bacterial population by gradient plate method. • To perform antibiotic sensitivity test against different pathogens. • Production of ethanol. • Diagnosis of typhoid, tuberculosis . • Diagnosis of HIV • Diagnosis of Hepatitis A, B and C. • Immunological diagnosis of pregnancy	30

OUTCOME: The major outcomes of this course are:

CO1- After completion of module student will be able to check the quality of different dairy products.

CO2- In addition to this students are able to isolate and diagnose different kinds of bacteria and viruses.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1,PO2, PO4, PO5, PO6, PO7, PO8 /PSO1, PSO2, PSO3

MSMO 0801: ENVIRONMENTAL MICROBIOLOGY LAB

COURSE OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Environmental Microbiology that they have taught in the theory and provide hands on training.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To measure the D.O. of the given water samples. • To measure the BOD of the given water samples. • To measure the COD of the given water samples. • To enumerate the microbial flora in wheat flour by standard plate count. • To determine the bacterial count in milk by direct microscopic method. • To determine the effect of temperature on microbial growth. • To determine the effect of pH on microbial growth. • To determine the effect of oxygen on microbial growth. • To determine the hardness of the given water samples.	15

OUTCOME: The major outcomes of this course are:

CO1- After completing the practical course, students will be able to examine Physico-chemical nature of environmental samples.

CO2- In addition it can enhance the ability to understand related theory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1,PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4

MSBO 0801: NANOBIOTECHNOLOGY LAB

COURSE OBJECTIVES: The objective of this laboratory includes synthesis ,production and applications of nanoparticles.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Chemical Synthesis of silver Nano Particales (sodium borohydride) • Chemical Synthesis of silver Nano Particles (trisodium citrate) • Characterization of silver Nano Particles (By UV spectrophotometer) • Antibacterial activity of silver Nano Particles • Biological Synthesis of silver Nano Particles • Chemical Synthesis of Gold Nano Particles (Citrate Synthesis) • Characterization of Gold Nano Particles (By UV spectrophotometer • Antibacterial activity of gold Nano Particles • Biological Synthesis of gold Nano Particles	15

OUTCOMES: After completion of course, the student will be able to:

CO1- To have knowledge of nano material properties and characterization.
CO2- To use the tools, techniques and skills necessary to practice.
CO3- To understand of the impact of nano materials on the environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1
CO3	PO1,PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBO 0802 : ENZYME TECHNOLOGY LAB

OBJECTIVES:

The objectives of this paper are to design experiments for the determination of enzyme kinetic parameters, conduct various types of enzyme activity assays on the basis of general methodological descriptions, analyze results from these assays in order to estimate enzyme activity, enzyme stability, thermal activation of enzymes, substrate saturation and inhibition constants and evaluate the validity of the enzyme kinetic results such i.e. considerations concerning the use of blank samples, substrate specificity, use of artificial or multiple component substrates and heterogenous enzyme preparations.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To estimate standard curve of pNP so as to measure the activity of enzyme acid phosphatase • To find out the activity or amount of enzyme acid phosphatase in unit per gram of potato tissue • To find out the specific activity of enzyme acid phosphatase • To study the effect of substrate con. on the activity of enzyme acid phosphatase • To determine value of Km and Vmax of enzyme acid phosphatase by using following graph (i) Michaelis- Menton graph (ii) Lineweaver Burk plot (iii) Hofstee's plot • To study the effect of temperature on the activity of enzyme specific activity and determination of optimum temperature • To study the effect of pH on the activity of enzyme specific activity and determination of optimum Ph	15

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1- Understand enzyme assay system, which will help them to cope up with research and industry related to enzymology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1, PSO2

MSBO 0803: CLINICAL RESEARCH IN MEDICINAL PLANTS LAB

OBJECTIVES: To understand the medicinal values of plants

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Authentication of Medicinal plants • Importance of seasons, climate and other environment factors on components of medicinal plants • Preparation of different parts of medicinal plants for their extract preparation • Methods used for preparation of plant extract • Phytochemical analysis of plant extract • Quantitative estimation of component(s) of plants of medicinal value	15

COURSE OUTCOMES: After completion of course, the student will be able to:

PO1- To have knowledge of traditional medicine (ayurveda and its role) in treatment of diseases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO6, PO8 /PSO1, PSO2

MSMO 0802 : ANIMAL CELL CULTRE LAB

OBJECTIVES: This course aims to impart in students an understanding of the primary cell culture and methods that convert them to long term established cultures. They will be exposed to all the factors which could impact cell culture and equipment requirements for propagation.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Introduction to cell culture laboratory and instruments (Inverted microscope, CO_2 incubator, Refrigerated centrifuges, Bio-safety cabinets, cryo cans, UV lights etc) used in the lab • Washing and Sterilization of glass wares, plastic ware and different buffer/ media for animal tissue culture • Preparation of tissue culture medium trypsin • Counting of cells by haemocytometer. • Preparation of single cell suspension from spleen • Trypan blue viability check method for animal cells.	15

OBJECTIVES: After completion of course, the student will be able to:

CO1- At the end the students will demonstrate the ability for development of primary established cell culture.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2, PSO4

MSMJ 0971: PROJECT WORK

Credits: 16 **Semester IV** **L–T–P: 0–0–0**

Module No.	Content	Teaching Hours
I	Project work	Six months