Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(An Autonomous college)

Lead College, Karmaveer Bhaurao Patil University, Satara

Reaccredited by NAAC "A Grade

Syllabus for Master of Science

Part-I

APPLIED MICROBIOLOGY

Syllabus

To be implemented from June, 2023

(As Per NEP-2020 Guidelines)

A. RULES AND REGULATIONS:

1. Any person who has taken the degree of B. Sc. of this Institute or the degree of any other statutory University and has kept four terms in the Institute as post-graduate student be admitted to the examination for the degree of Master of Science (M. Sc.) in Applied Microbiology.
2. A student shall be held eligible for admission to the M. Sc. Applied Microbiology course provided s/he has passed the B. Sc. examination with Microbiology as a principal subject or with a subsidiary/interdisciplinary/applied/allied subjects and has passed the entrance examination conducted by the Institute.
3. The students with B. Sc. from other universities shall be eligible if they qualify through the entrance examination.
4. While preparing the merit list for M. Sc. admission, the performance at the performance at the entrance examination should be considered.
5. The examination shall be split up into four semesters.
6. The commencement and conclusion of each semester shall be notified by the Institute from time to time.
7. A student who has passed in semester examination shall not be allowed to take the examination in the same semester again.
8. Each theory Course in each semester as well as each practical course shall be treated as separate head of passing.
9. The result shall be declared at the end of each semester examination as per Institute rules.

B. SYLLABUS FOR MASTER OF SCIENCE (M.Sc.):

1. **Title: Subject: - APPLIED MICROBIOLOGY**
2. **Year of implementation: June 2023 onwards**
3. **General Objectives of the Course:**

A prime objective to maintain updated curriculum and providing therein inputs to take care of fast paced developments in knowledge of Applied Microbiology and in relation to international context, a two-year programmed is formulated for M.Sc. Applied Microbiology as per UGC guidelines and to develop competent microbiologists to achieve desirable placements in the country and abroad. The programmed obliges students to read original publications and envisages significant inputs in the laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertake in addition to other disciplines viz. Virology, Immunology, Genetics, Molecular Biology, Analytical techniques, Enzymology, Biostatistics, Bioinformatics, Scientific writing, Computer Science etc.

The overall structure of the course to be implemented from the academic year 2023–2024 onwards is as given below. Students are required to undertake a research project in all the semesters at the department. In the project, the student is expected to study research methodology that includes literature survey, experimental work and report writing following the IMRAD (Introduction, Aims and objectives, Materials and Methods, Results and Discussion) system. Students shall compulsorily deliver one seminar/research Course before submission of project and submit a certificate from the Head of the Department regarding satisfactory completion of the same at the time of the practical examination of semester IV. Students are also required to undertake a compulsory educational tour organized by the Department in each year (M. Sc. I and M. Sc. II) to various places of microbiological interest and submit a tour report duly signed by the Head of the Department, at the time of the practical examinations respectively. Students shall also undergo industrial training at the end of M.Sc. I through compulsory internships.

4. **Duration:**

- The course shall be a full-time course.
- The course shall be of two years, consisting of four semesters.

5. **Fee Structure:**

- **Entrance Examination fees:** as prescribed by the Institute.
- **Course Fee:** as prescribed by the Institute.

6. Eligibility for Admission:

- As per Rule (2) for graduates of this Institute.
- As per Rule (3) for graduates from other universities and merit of entrance exam.

7. Medium of instruction: English

8. Structure of the Course

Level	Sem	Major			RM	OJT	RP	Total
		DSC Mandatory		DSE Elective				
		T	P	T				
6	I	12 (3 Papers)	2	4 (1 paper out of two)		---		22
		12 (3 Papers)	2	4 (1 paper out of two)		---		22
6.5		12 (3 Papers)	2	4 (1 paper out of two)		---		22
		12 (3 Papers)	---	4 (1 paper out of two)		4		22
Total		48	6	16		4		88
		70			8			

M.Sc. Part I

Semester I

Nature of the Course	Course Code	Name of the Course
Theory	MAMiT 411	MICROBIAL BIODIVERSITY AND ECOLOGY
	MAMiT 412	RECENT TRENDS IN VIROLOGY
	MAMiT 413	MICROBIAL BIOCHEMISTRY AND PHYSIOLO
	MAMiT 414 E-I	ESSENTIALS OF GENETICS
	MAMiT 414 E-II	ADVANCED GENETICS
	MAMiT 415	RESEARCH METHODOLOGY
Practical	MAMiP 416	PRACTICAL COURSE I: LAB I BASED ON (MAMiT 411,412,413)

Semester II

Nature of the Course	Course Code	Name of the Course
Theory	MAMiT 421	INDUSTRIAL MICROBIOLOGY
	MAMiT 422	MICROBIAL METABOLISM
	MAMiT 423	ANALYTICAL TECHNIQUES
	MAMiT 424 E-I	QUALITY MANAGEMENT IN PHARMACEUTICAL INDUSTRY
	MAMiT 424 E-II	PHARMACEUTICAL MICROBIOLOGY
	MAMiT 425	RESEARCH PROJECT
Practical	MAMiP 426	PRACTICAL COURSE II: LAB III BASED ON (MAMiT 421,422,423)

SEMESTER I

MAMiT 411: MICROBIAL BIODIVERSITY AND ECOLOGY

Course Objectives: Students should be able to: -

1. Study the basics of microbial systematics.
2. Understand Domains Eukarya, Eubacteria, and Archaea along with their component groups.
3. Understand the significance and global environmental issues of microbial diversity.
4. Study the basics of chemotaxonomy.

Credits	MICROBIAL BIODIVERSITY AND ECOLOGY	No. hours unit/ Credits
Credit I	**UNIT I: Basic Concepts of Microbial Systematics**	**(15)**
	A) Microbial Systematics: Classification and Techniques I)Introduction: Need for classification of microorganisms, overview, aims and objectives. II)Techniques for Classification: a) On the basis of Serology. b) Chemotaxonomy – ● Cell Wall Composition Analysis. ● Lipid and Fatty Acid Profiling. ● Protein Profiling. ● Isozyme Analysis. ● 16s rRNA Analysis. **B) Approaches for Exploration of Uncultivable Microbes** I) Introduction: Basic outline of uncultivable Microorganisms. II) Culture independent molecular methods III) Methods of extracting total microbial DNA from habitats. Metagenomics	

Credit 1	**UNIT II: Domain Eukarya**	**(15)**
	Introduction: General review and significance of domain Eukarya. **General Classification, Salient Features, and Industrial Significance of –** Phylum Fungi. Yeasts. Molds. Algae. Protozoa	
Credit 1	**UNIT III: Domains Archaea and Eubacteria**	**(15)**
	Introduction: General review and significance of domains Archaea and Eubacteria. **General Classification, Salient Features, and Industrial Significance of –** Domain Archaea. Domain Eubacteria-Actinobacteria. Cyanobacteria. Mycoplasma. Myxobacteria Rickettsia**.**	
Credit I	**UNIT IV: Global Environmental Issues and Significance of Microbial Diversity**	**(15)**
	A) Global environmental issues i) Introduction ii) Global Climate Change iii) Conservation Of Global Biodiversity **B) Significance of Microbial Diversity** Approaches to the examination of microbial diversity i) Bacterial Diversity ii) Fungal Diversity iii) Viral diversity	

Course Outcomes: Students will be able to:-

1. Comprehend the concepts of microbial systematics.
2. Analyze the domain system of microbial classification.
3. Differentiate between the constituent groups of domains Archaea, Eukarya, and Eubacteria.
4. Describe the significance and global environmental issues of microbial diversity

References: -

1. Bergey's Manual of Determinative Bacteriology.
2. Bergey's Manual of Systematic Bacteriology
3. Michael T. Madigan, Brock's Biology of Microorganisms (Benjamin-Cummings Pub Co; 13th edition, 17 December 2010
4. Moselio Schaechter (2004) The Desk Encyclopedia of Microbiology. Elsevier Ltd. British Library Cataloguing in Publication Data. Library of Congress Catalog Number: 2002114100 ISBN 0-12-621361-5
5. Oladele Ogunseitan (2005) Microbial Diversity. Blackwell Publishing Ltd.

MAMiT 412: RECENT TRENDS IN VIROLOGY

Course Objectives: Students should be able to: -

1. Study the evolution and classification of viruses.
2. Study the life cycles of selected groups of viruses.
3. Understand the role and significance of oncogenic viruses.
4. Understand the types of vaccines and antiviral drugs.

Credits 4	**MAMiT 412: RECENT TRENDS IN VIROLOGY**	**No. of hou per unit/ Credits**
Credit I	**UNIT I: Evolution and Classification of Viruses**	**(15)**
	***A)* Evolution of Viruses** i) Potential for rapid evolution in RNA viruses than DNA viruses. ii) Mechanisms of evolution. iii) Evolution of influenza virus. ***B)* Nomenclature and Classification of Viruses** i) Nomenclature and classification on the basis of a) Disease b) Host organism c) Partial morphology of virus d) Nucleic acid of virus e) Taxonomy ii) Concepts of Viroid, Prions, Slow Viruses, and DI particles. ***C)* Study of Virus Inhibition and Inactivation** i) Inhibition and inactivation of: a) Bacteriophages, b) Animal viruses, c) Plant viruses. ii) Methods of Virus Inhibition and Inactivation a) Photo dynamics b) Heat and Radiation c) Chemical. iii) Transmission of Viruses a) Modes of transmission: Horizontal, Vertical and Zoonoses. b) Animal models to study transmission.	
Credit I	**UNIT II: Life Cycles of Viruses**	**(15)**

	A) Study of Reproductive Cycles of Animal Viruses i) DNA Viruses: Herpes and Pox viruses. ii) RNA Viruses: Reo and Rhabdo viruses. **B) Reproductive Cycles of Bacterial Viruses** i) phi X 174 ii) RNA phages. iii) Lambda phages and the genetic regulation of lysogenic and lytic phases. **C) Lysogeny in Viruses** i) Study of lysogeny of μ phages. ii) Comparative study of lysogeny of P1, P2 and P22 phages. **D) Life Cycles of Emerging Viruses** i) Concept of Emerging Viruses. ii) Life cycle of Ebolavirus.	
Credit I	**UNIT III: Oncogenic Viruses**	**(15)**
	1) Introduction: *i)* Concept of Oncogenic Viruses. *ii)* Introduction to oncogenic viruses: RSV, SV40,HPV. **2) Oncogenes** i. Concept of oncogenes. ii. Classification and characteristics oncogenes and their proteins. iii. Genetic basis of cancer: Conversion of protooncogenes to oncogenes by mutation and viruses. iv. Oncogenic Mutations in Growth Promoting Proteins: • PDGF, b) Receptor Tyrosine Kinase. Erythropoietin Receptor, Ras Pathway, c-Fos, c-Myc. *ii)* Apoptotic gene as proto-oncogene or tumor suppressor gene *iii)* Mutations causing loss of growth inhibition and cell control – Rb, p53 protein.	

Credit I	UNIT IV: Vaccines and Antiviral Drugs	(15)
	1) Types of vaccines, their immune response an adverse reaction. a) Live Attenuated b) Inactivated c) Subunit d) Toxoid **2) Modern Vaccines-** DNA Vaccine, RNA Vaccine, Viral Vector Vaccines **3) Components of a vaccine-** a) Active ingredients c) Added ingredients c) Products used in the manufacture of a vaccine d) Growing the ingredients. i. General Approach and Screening of Antiviral Drugs. ii.Mechanisms of antiviral activity by inhibition of: *a)* Viral Entry. *b)* Replication of Viral Nucleic Acid. *c)* Viral Protein Functionality. iii. Drug resistance among viruses to antiviral drugs. Bacterial Phage Therapy	

Course Outcome: Students will be able to

1) Summarize the evolution and classification of viruses.
2) Comprehend the life cycles of selected groups of viruses
3) Explain the importance of oncogenic viruses.
4) Differentiate between various types of vaccines and antiviral drugs.

References: -

1. S.J. Flint, Principles of Virology, 3rd Edition, Vol. I and Vol. II, (American Society for Microbiology, 6 February 2009)
2. Edward K. Wagner, Basic Virology, 3rd Edition (Wiley-Blackwell Publiations, October 29, 2007)
3. Ajit K. Banerjee, Fundamentals of Microbiology & Immunology –
4. Straus J.H., Evolution of RNA Viruses
5. Longman, Introduction to Plant Virology
6. N.J. Dimmock, A.J. Easton, Introduction to Modern Virology, 6th Edition
7. Luria, Virology
8. WHO Vaccine Safety Basics E learning Course- Module 2-Types of vaccines and adverse reactions https://vaccine-safety-training.org/overview-and-outcomes- 2.html

MAMiT 413: MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY

Course Objectives: Student should be able to-

1. know the essentials of amino acids and proteins.
2. Study the properties, structures and role of saccharides, lipids, and vitamins.
3. Understand the fundamental nuances of bioenergetics and photosynthesis.
4. Study the branch of bacterial chemolithotrophy.

Credits 4	**MAMiT 413: MICROBIAL BIOCHMISTRY AND PHYSIOLOGY**	**No. of hours per unit/ Credits**
Credit I	**UNIT I: Amino Acids and Proteins**	**(15)**
	a. Amino Acids i.Structure and Classification of Amino Acids – a) Basic, b) Acidi c) Neutral. ii. Properties of Amino Acids – 1. Acid base nature, b) Titration 2. Curve of glycine, c) Electriccharge. iii. Peptide bond and itsnature. iv. Peptide. Ionization behavior 1. Polypeptide and its Diversity- Size and Composition **b. Proteins** i. Structural levels of proteins 1.Primary Structure (oxytocin). 2. Secondary Structure – alpha helix, B-sheet, B-turn (α keratin). 3. Tertiary Structure (Myoglobin). 4.Quaternary Structure (Hemoglobin). ii. Protein stability and forces stabilizing protein structure. iii.Ramachandran plot. iv. Denaturation and Renaturation of protein. v.Protein Folding 1. Folding pathways for protein structure. 2. Concept of chaperon and its role in protein folding. 3. .Diseases caused by misfolding – an overview.	

Credit I	UNIT II: Carbohydrates, Lipids and Vitamins	(15)
	a) Carbohydrates i) Definition and Functions-carbohydrates. ii) Monosaccharides Classification and structures of aldoses and ketoses. Configuration and Conformation. iii) Disaccharides: Lactose and Sucrose. iv) Polysaccharides Types of polysaccharides -. Homopolysaccharide- i. Stearic forces and hydrogen bonding in homopolysaccharide folding. ii. Structure and Role of Starch, Glycogen, Cellulose iii. Heteropolysaccharide- Heparin, Hyaluronate. v) Glycoconjugates – Proteoglycan, Glycoproteins, Glycolipids. **b) Lipids** i) Definition, General Properties and Functions of Lipids. ii) General Formula and Nomenclature of Fatty Acids: iii) Classification of Lipids Even and Odd Scheme of Nomenclature. Saturated and Unsaturated Fatty Acids. PUFA(Poly Unsaturated Fatty Acid) and its chemical properties. iv) Structure, General Properties and Functions of: a) Simple Lipids (Triacylglycerols). b) Complex Lipids (Phosphoglycerides – Lecithin, Sphingolipids – Sphingomyelin). c)Derived Lipids- Sterols –Cholesterol, Ketone Bodies	

	c) Vitamins i) Definition, classification, and General Properties. ii)Structures and Forms of Coenzymes. Mode of Action, Sources, iii) Daily Requirement and Deficiency s - Study of- a)Thiamine, b) Riboflavin, c) Ascorbic Acid	
Credit I	**UNIT III: Bioenergetics and Photosynthesis**	**(15)**
	A) Bioenergetics: i) Principles and Laws of Thermodynamics ii) Reaction Profile – Oxidation, Reduction, Redox couples. iii) Oxidative Phosphorylation Architecture of Mitochondria. Electron Transport Chain (ETC) reactions in mitochondria. iv) Mechanism of ATP Synthesis by Chemiosmotic Model. v) Uncouplers and Inhibitors of ETC. vi) ETC Process in Prokaryotes. B) Photosynthesis i) General Features of Photophosphorylation. ii) Evolution of Oxygenic Photosynthesis. iii) General Photochemical Events – Light driven electron flow. Photochemical Reaction Centers in Bacteria a) Pheophytin- Quinone Center and Fe-S Center. b) Photosystem II in Cyanobacteria. c) Photosynthetic Pigments in Halobacterium. v) Photochemical Reaction Centers in Plants a)Photosystems I and II. b)Electron Flow in PS I and PS II – Z Scheme.	

	vi) ATP Synthesis by Photophosphorylation	
redit I	**UNIT IV: Bacterial Chemolithotrophy**	**(15)**
	a) Introduction Overview and Modes of Microbial Metabolism. **b) Chemolithotrophs** i) General features of chemolithotrophs. ii) Physiological Groups of Chemolithotrophs. iii) Types of Chemolithotrophic Reactions with examples: a) Ammonia Oxidation. b) Nitrite oxidation. c) Oxidation of Molecular Hydrogen. d) Ferrous and Sulphur Oxidation.	

Course Outcomes: Student will be able to: -

1) Draw structures of different amino acids and describe their properties
2) Comprehend the properties and importance of saccharides, lipids, and vitamins.
3) Explain the mechanism of ATP synthesis by chemiosmotic Model
4) Describe various types of bacterial chemolithotrophic reactions

References: -

1. David L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry:

6th Edition – (W. H. Freeman, 13 February 2013)
2. Jeremy M. Berg, Lubert Stryer, Biochemistry, (WH Freeman, 8 April 2015)
3. David T. Plummer An introduction to practical biochemistry- 3rd edition, (McGraw Hill Education, 1 July 2017)
4. B. Buchanan, W. Cruissem, R. Jones, Biochemistry and Molecular Biologyof Plants (Wiley Publishing, 4 September 2015)
5. David Metzer, Biochemistry – Chemical Reactions of Living Cell, Vol. Iand II (Academic Press, 4 May 2003)
6. Michael T. Madigan, Brock Biology of Microorganisms (Benjamin- Cummings Pub Co, 17 December 2010)
7. H.W. Doelle, Bacterial Metabolism (Academic Press, 28 June 201

MAMiT 414 E1: ESSENTIALS OF GENETICS

Course Objectives: Student should be able to -

1. Study the essentials of Mendelian and Non-Mendelian inheritance.
2. know the basics of multiple alleles, essential genes, and lethal genes.
3. learn properties, structures of chromosome and their packaging
4. understand the pedigree analysis and various genetic disorders in humans

Credits 4	**SEMESTER-I** **MAMiT 414 E1: ESSENTIALS OF GENETICS**	**No. of hours unit/ Credits**
Credit I	**UNIT: I Mendelian and Non-Mendelian Genetics**	**(15)**
	I) Mendelism: a) Monohybrid crosses and Mendel's' Principle of segregation. b) Dihybrid crosses and Mendelian principle of independent assortment c) Epistasis d) Statistical analysis of Genetic data. The Chi-square test. e) Multiple alleles – ABO blood groups. f) Essential genes and lethal genes. g) The environment and gene expression codominance, incomplete dominance, pleiotropy. h) Sex linkage, Sex limited & influenced characters **II)**Non-Mendelian Inheritance**:** a) Determining Non-Mendelian Inheritance b) Maternal effects. c) Cytoplasmic inheritance (Mitochondria, chloroplast, infective particles)	

Credit I	**UNIT II: Chromosomes and their packaging**	**(15)**
	I) Structure of chromosomes: a Lamp brush chromosomes b. Polytene chromosomes II) Heterochromatin – defense against mobile DNA elements. a) Mitotic chromosomes – their patterns b) Mitotic chromosomes – their patterns III)Chromosomal DNA and its packaging: a) Procaryotic and eukaryotic chromosome unique & repetitive DNA sequences b) Nucleosome core particle – Histone, non-histone c) ATP-driven chromatin remodeling machines. d) Covalent modification of Histone tails e) Split genes – Exon, Intron, f) Splicing mechanism i) Autocatalytic RNA ii) Spliceosome	
Credit I	**UNIT III: DNA damage and repair**	**(15)**
	I. DNA Repair a) Error-free mechanism– i) Mismatch repair. Base excision repair. ii) Nucleotide excision repair. iii) Direct repair. b) Error prone mechanism- *II.* DNA Recombination. a) Homologous genetic recombination. b) Site specific recombination. c) Eukaryotic transposons.	

Credit I	**UNIT IV: Human Genetics**	**(15)**
	I. Pedigree analysis, II. Lod score for linkage testing, III. Karyotype IV. Genetic disorders- Hemophilia, Colour blindness, Hungstinson's disease Quantitative genetics- polygenic inheritance, heritability and its measurements, QTL mapping	

Course outcomes : Students will be able to-

1. Differentiate between Mendelian and Non-Mendelian inheritance
2. Describe the structural levels of chromosomes.
3. Explain DNA repair and gene recombination mechanisms.
4. Analyze pedigree and predict various genetic disorders in humans.

REFERENCES:

1. Gardner, M. J. Simmons, Principles of Genetics (Wiley Publishing's, 12 December 2006)

2.Jocelyn E Krebs, Lewin's Genes X (Jones & Bartlett Learning, 1 January 2009)

3.John Cronan , David Freifelder, Microbial Genetics (Narosa Publishers, 1 January 2008) - 4.David L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry: 6th Edition – (W. H. Freeman, 13 February 2013)

5. Harvey Lodish, James E. Darnell, Molecular Cell Biology. (W.H. Freeman & Co Ltd, 18 August 2003)

6. Anthony JF Griffiths, Jeffrey H Miller, An introduction of Genetic Analysis 10th Edition.(Freeman, 2010

MAMiT 414 E2: ADVANCED GENETICS

Course Objectives: Students should be able to -

1. Study the fundamentals of gene therapy
2. Know the basics of stem cell research
3. Understand genetic counseling
4. Learn population genetics

Credits	SEMESTER-I MAMiT 414 E2: ADVANCED GENETICS	No. of hours unit/ Credits
Credit I	**UNIT I: Gene Therapy**	**(15)**
	i) Fundamentals of gene transfer Viral vectors for gene therapy Non-viral gene transfer: Plasmids and DNA vaccines; Balistic methods; Liposomes; Engineered zinc-finger nucleases Lentiviral and adenoviral vectors for correction of single gene disorders; trials in animal models ofhuman disease. ii) **Gene therapy of inherited or acquired diseases**- Cystic fibrosis; Inherited coagulopathies and HIV infection. iii) Safety issues in preclinical and clinical gene therapy Italian and international laws and safety Ethic issues concerning fetal or germinal cell gene therapy	

Credit I	**UNIT II: Stem Cell Research**	**(15)**
	I) Introduction to stem cells Definition, properties, proliferation, culture of stem cells, medical applications of stem cells II)Types of stem cells Stem Cell biology and therapy, types embryonic stem cell, Adult stem c Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology III) Therapeutic applications of stem cells IV) Ethical Issues associated with stem cell-based regenerative medicine field . Regulatory and Ethical Considerations of stem cell and Gene Therapy,Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies	
redit I	**UNIT III : Genetic Counseling and Ethics**	**(15)**
	Genetic screening and pre-implantation genetic diagnosis; Clinical, psychosocial, and ethical aspects of human genetics research; case studies Carrier detection, Forensic studies and paternity testing; Cord blood banking, New born screening in genetic disorders, genome editing Prenatal Counseling Biochemical screening – timing, methods, result interpretation. Counseling regarding various prenatal diagnosis techniques, risks associated with invasive procedures, interpretation of laboratory results and their limitations. Observe foetal samp procedure (amniocentesis, chorionic villus sampling, cordocentesis)	

Credit I	UNIT IV: Human Evolutionary Genetics:	(15)
	i) Population Genetic Theory and Statistical Methods: Basic concepts in population genetics as well as the most important statistical methods for investigating demographic and evolutionary models using the distribution of genetic variation in time and space. ii) Human evolutionary history: Human demographic history including the relationship with archaic people (Neanderthals), "out-of-Africa migration," and the spread of agriculture in Europe and how these hypotheses find support in the distribution of genetic variation. Molecular Evolution-amino acids and nucleotide substitutions, synonymous codon; Molecular divergence and molecular clock..	

Course outcomes: Students will be able to-

1. Explain gene therapy of acquired diseases.
2. Apply the therapeutic applications of stem cell research.
3. Explain various types of stem cells and potential benefits of stem cell technology
4. Describe the human evolutionary theory and concept in population genetics

References:

1. Human Molecular Genetics, Strachan T and Read AP – Garland Science
2. Genomes, Brown TA – Wiley Liss
3. Human Genetics and Genomics, Korf BR - Wiley
4. The Book of Genes and Genomes, Willard and Haga, - Springer
5. Modern Genetic Analysis, Griffiths AJF, Gelbart WM, Miller JH et al., - Freeman
6. An Introduction to Genetic Analysis, Griffiths AJF, Miller JH, Suzuki D T et al., - Freeman

MAMiT 415: RESEARCH METHODOLOGY

Course Objectives:

The student should be able to: -

1. Study the basic knowledge on the fundamentals of research methodology.
2. Understand to present research in scientific manner.
3. Get acquainted with different bio statistical tools in modern research.
4. Understand the relationship between statistics and biological research.

Credits 4	**MAMiT 415: RESEARCH METHODOLOGY**	**No. of hours p unit/ credits**
Credit I	**UNIT I: Introduction to Research Methodology I**	**(15)**
	A) Research Methods vs. Methodology Introduction. ii) Types: Library research, field research, laboratory research. Defining a Research Problem Concept. Selecting the research problem. Techniques involved in defining problem. Conclusion of the problem. Research Design Need for research design. Concept in research design. Types of research design. D)Developing a Research Plan i) Need. ii) Essential characteristics of research plan.	
Credit I	**UNIT II: Introduction to Research Methodology II**	**(15)**

	A) Reporting Practical and Project Work Structure of report ii) Title, authors and their institution, abstract, keywords, abbreviations. IMRAD technique a) Introduction b) Material and methods c) Result discussion and conclusion d) Acknowledgements B) Preparing a Grant Proposal for Research Project C)Manuscript Submission to Research Journals Statement of proposal. Ethical considerations.) Publishing editorial issues. iv) Preparation and submission.	
Credit I	**UNIT III: Descriptive Statistics**	**(15)**
	. A) Importance of statistics in Biology Samples and Population ii) Types of data, random sampling methods and sampling errors, scales and variables, accuracy and precision. B) Measures of Central Tendency i) Mean (arithmetic, geometric, harmonic), median, percentile and mode. ii) Measures of dispersion – mean deviation, standard deviation and variance. Measures of a) Skewness, b) Kurtosis.	

Credit I	**UNIT IV: Hypothesis Testing**	**(15)**
	A) Introduction to Hypothesis Testing i) Null hypothesis ii) Alternate hypothesis. B) Statistical Tools i) Significance level, type I and type II errors, p-value, one tailed and two tailed tests. ii) Distribution of sample means, standard error and confidence interval, Degrees of freedom Equality of two population means, proportions: t- tests and ztest iv) Chi square test - test for goodness of fit, independence and homogeneity F test and ANOVA	

Course Outcomes:

Students will be able to:-

1. Design a research plan.
2. Present research in scientific language.
3. Analyze research data employing biostatistical tools.
4. Statistically signify the importance of research data.

References: -

1. N. Gurumani, Scientific thesis writing and Paper presentation, (MJP Publishers, Chennai, 2010) – UNIT I, II.
2. C. R. Kothari, Research Methodology; Methods and Techniques,2 ndEd, (New Age International Publishers, New Delhi, 2004) - UNIT I, II.
3. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3 rd (Ukaaz, Publications, Hyderabad, 2004) - UNIT III, IV.
4. Robert R. Sokal and F. James Rohlf, Introduction to Biostatistics,2ndEd, (Dover Publications, INC. Mineola, New York,1969) – UNIT III, IV.
5. P.N. Arora, P.K.Malhan , Biostatistics, (Himalaya Publishing House, Mumbai, 2006) – UNIT III, IV.

M.Sc.Part-I, Sem.I MAMiP 416 Practical
(Based on MAMiT 411,412,413 courses)

Course objectives: Student should be able to -

1. Understand the techniques of isolation.
2. Study the identification and morphological characters of microorganisms.
3. Learn the estimation and quantification of macromolecules (protein, carbohydrates, DNA/RNA).
4. Understand the characterization methods of microorganisms.

Credit 2	**MAMiP 416 Practical Course (LAB-I)**	**No. of hour -(60**
	Isolation, Identification & Characterization of Actinomycetes. Isolation, Identification & Characterization of Yeasts. Isolation, Identification & Characterization of Molds. Isolation & Characterization of Microaerophilic Microorganisms Isolation, Identification & Characterization of *Cyanobacteria* and *Nostoc.* Isolation, Identification & Characterization of *Oscillotoria.* Morphological studies of Algae- *Chlorella* and *Spirulina*. Induction of ascospores in *S. cerevisiae.* Isolation, and identification of spores of VAM fungi from soil. Isolation of plaque morphology mutant of phages by using U.V. radiation. Demonstration of Egg inoculation technique. Determination of cross infectivity of *E. coli* with *Pseudomonas, Salmonella & Proteus vulgaris* phages Phage typing of *E.coli.* Estimation of bacterial protein by Lowry method. Quantitative estimation of amino acids by using ninhydrin method. Estimation of DNA by Diphenylamine method. Isolation and Estimation of RNA from yeast (Bials orcino method). Isolation & characterization of photosynthetic pigments	

Course outcomes: Student will be able to -

1. Perform the techniques of isolation of different types of micro organisms
2. Identify and describe morphological characters of microorganisms.
3. Determine and perform the methods of estimation and quantification of macromolecules (protein, carbohydrates, DNA/RNA)
4. Perform the characterization methods.

REFERENCE:

1. David T. Plummer An introduction to practical biochemistry- 3 rd edition, (McGraw Hill Education, 1 July 2017)
2. . William M. O'Leary Practical handbook of microbiology (CRC Press, January 1, 1674)
3. D.K Maheshwari, R.C.Dubey Practical microbiology – (S. Chand Publishing, 2021)
4. Rashmi A. Joshi A, textbook of practical biochemistry (B.Jain Large Print, 1 April 2006)
5. William M. O'Leary Practical handbook of microbiology (CRC Press, January 1, 1674)
6. D.K Maheshwari, R.C.Dubey Practical microbiology – (S. Chand Publishing, 2021

Semester II

MAMiT 421 – INDUSTRIAL MICROBIOLOGY

Course Objectives: Student should be able to:-

1. Understand the basic concepts of fermentation technology.
2. Study the significance of microbial sensors.
3. Study economical aspects of solid-state fermentation.
4. Learn with various concepts related to intellectual property.

Credits 4	**MAMiT 421 – INDUSTRIAL MICROBIOLOGY**	**No. of hou per unit/ credits**
Credit I	**UNIT I: Fermentation Technology**	**(15)**
	Bioreactor Design and operation. ii) Batch culture fermenter: Main parts, peripherals parts accessories, alternative vessel design, types of instrumentation, common measurement and control system, sensors. Simple continuous culture: Accessories and peripherals. Fermenter preparation and use. Inoculation techniques in a bioreactor, sampling from fermentervesse Maintenance of fermenter components. Type of organism used in fermentation. Sub fermenter system – a new approach. Solution to common problems in fermentation.	
Credit I	**UNIT II: Microbial Biosensors**	**(15)**

	Concept of Biosensors Cell Immobilization - Introduction, Immobilized cell system – i) Surface attachment of cells. ii)Entrapment within porous matrices.iii)Containment behind a barrier. iv)Self-aggregation of cells b) Design of immobilized cell reactors – i) Mass transport phenomena in immobilized cell system. ii)Reaction and diffusion in immobilized cell system iii)Bioreactor design iv)Physiology of immobilized microbial cells. B) Types of electrochemical microbial sensors i)Optical biosensors ii) other types	
Credit I	**UNIT III: Solid State Fermentation and Fermentation Economics**	**(15)**
	A) Solid state fermentation (SSF) :- Introduction, comparison of SSF and submerged fermentation, Advantages, disadvantages, problems, types, Factors affecting, fermenterdesign for SSF, Koji manufacturing process, industrial application of SSF, amylase production – case study. B] Fermentation economics:- Introduction, economic objectives. Various aspects influencing fermentation economics Strain improvement, High yielding strain, Marketpotential, fermentation media and raw material, fermentation equipment's,recovery cost, water uses and recycling, effluent treatme	
Credit I	**UNIT IV: IPR and Patenting**	**(15)**
	A) Intellectual Property Rights Introduction and concept of IPR, the World Intellectual PropertyOrganization (WIPO),Fields of intellectual property protection, General introduction to patents,copyrights and trademarks. A) Patents: i)Introduction, conditions of patentability, drafting and filing a	

	patent,examination of a patent application, infringement, exploitation the patented invention, compulsory licenses. Utility models ii) Indian Patent Act C]Intellectual Property and Bioethics: Introduction, general principles and key aspects.	

Course Outcomes: Students will be able to:-

1. Use and manipulate different types of fermenters and fermentation process.
2. Describe and design of immobilized cell reactors.
3. Apply the technique of solid-state fermentation for laboratory production of metabolites.
4. Describe bioethical concepts and fundamentals for social welfare

References:-

1. Mansi E. L. (2011) Fermentation Microbiology and Biotechnology (2nd Edition), CRCPress – UNIT I, II.

Patil S.C. (2010) Industrial Microbiology, S. Chand and Company –UNIT II.

2. Casida J.R. (2016) Industrial Microbiology, New Age International Pvt. Ltd. – UNIT III.

3. Peppler H.J., Pearlman D. (1979)Microbial Technology (2nd Edition), Academic Press –UNIT III.

4. Stanbury P.P., Whitekar A., Hall S.J. (2008) Principles of Fermentation Technology,Elsevier – UNIT III.

Intellectual Property Rights in India, Shodhganga, Chapter 2 – UNIT IV.

5.WIPO Intellectual Property Handbook (2004) 2nd Edition, Chapters 1 and 2 – UNIT IV.8.Intellectual Property and Bioethics: An Overview – WIPO Booklet –UNIT IV

MAMiT 422: MICROBIAL METABOLISM

Course Objectives: Students should be able to:

1. Study the concept of pH and biological buffer system
2. know the enzymology, and enzyme kinetics.
3. Learn pathways in the utilization of different substrates in *E. coli*.
4. Understand the mechanism of Beta oxidation and fatty acid synthesis in lipid metabolism

Credits 4	**MAMiT 422: MICROBIAL METABOLISM**	**No. of hours per unit/ credits**
Credit I	**UNIT I: Bacterial Permeation**	**(15)**
	Concept of pH and buffers: Ionization of water, weak acid and weak bases. pH – pH scales, Bronsted Lowry concept of acids and bases. Buffer – Buffer solutions, Henderson Hasselhalch equation. Biological buffer system – Phosphate buffer system, bicarbonate buffer system, proteins, amino acids. Membrane biochemistry: Components of membrane, Membrane structural models, Methods to study diffusion of solutes. Eukaryotic and prokaryotic protein transport systems, Membrane protein. Ion channels K+, Na+, Cl - Na +/ K+ pump	
Credit I	**UNIT II: Essentials of Enzymology**	**(15)**
	Enzymes: a) Structure, function & reaction mechanism of - i) Pyruvate dehydrogenase ii) Fatty acid synthetase iii) ATPase b) Allosteric enzymes - i) Concept of allosterism ii) Positive and c) negative cooperativity. iii) Structural aspects of allosteric enzymes and their significance in regulation. c) Mechanism of action of enzymes- i) Single displace reaction. ii) Double displace reaction	

	Enzyme kinetics: Historical aspects b) Methods used for investigating the kinetics of enzyme catalysed reactions –initial velocity c) Michaelis Menten equation, graph, progressive curve and its significance. d) Alternative plots – Line weaver Burk Plot, Eadie Hofstee plot. 3) Enzyme inhibition: Significance, One example, Michaelis Menten equation,M.M graph, L.B.equation & graph for Competitive inhibition Noncompetitive inhibition Un- Competitive inhibition..	
Credit I	**UNIT III: Carbohydrate and Lipid Metabolism**	**(15)**
	Pathways in Utilization of different substrates in E. coli. Overview of glucose metabolism Substrates other than glucose – Fructose Lactose -Transport and breakdown of lactose, utilization of galactose. Acetate Pyruvate Malate Relation with TCA and glyoxylate bypass. Gluconeogenesis. Lipid Metabolism. Beta oxidation – pathway and regulation. Role of acyl carnitine in fatty acyl transport. Synthesis of fatty acid *d)* Structure and composition of fatty acidsynthetase complex reaction and regulation. Synthesis of triacylglycerides. Ketone bodies – formation and utilization.	

Credit I	UNIT IV: Signaling and Stress Response in Microbes Lectures	(15)
	Microbial response to stress: Microbial stress response, Stress proteins, and their roles, Cold and heat shocks Oxidative and starvation stress Signaling and Behavior in Procaryotes: Adaptive responses by facultative anaerobes to anaerobiosis *b)* Regulatory system. Two components signaling system. Porin structure h) Common signaling systems of plants, microbes & mammals	

Course outcomes: Students will be able to-

1. Recall various biochemical processes and communication in bacteria
2. Discuss methods used for investigating the kinetics of enzyme catalyzed reactions
3. Explain pathways involved in carbohydrate and lipid metabolism.
4. Explain signaling and stress response in microbes.

REFERENCE:

1. K. Wilson, J. Walker, Principles and Techniques of Biochemistry and Molecular Biology (Cambridge University Press, 3 November 2006)
2. Jeremy M. Berg, Lubert Stryer, Biochemistry, (WH Freeman, 8 April 2015).-
3. J L Jain, Sunjay Jain, Fundamental of Biochemistry (S Chand Publications, 1 January 2016)
4. R.L. Foster, Nature of Enzymology (Croom Helm Ltd, 1 November 1979) –
5. Trevor Palmer, Philip L. R Bonner, Enzymes: biochemistry, biotechnology and clinical chemistry (Woodhead Publishing, 4 April 2007)
6. G. Gottschalk, Bacterial Metabolism (Springer Publishing, 19 December 1985) .-
7. Geoffrey Zubay, Biochemistry (Brown (William C.) Co, U.S, 1 April 1997)
8. David White, The Physiology and Biochemistry of Procaryotes (Oxford Uni. Press, 2 December 2011)
9. Doelle H.W, Introduction to bacterial metabolism (Academic Press:1975

MAMiT 423:ANALYTICAL TECHNIQUES

Course objectives: Students should be able to:

1. Study the details of microscopy and electrophoretic techniques.
2. Understand the principles and types of chromatography.
3. Learn principles and various types ofcentrifugations.
4. Know various methods of protein purification.

Credits 4	**MAMiT 423: ANALYTICAL TECHNIQUES**	**No. of hou per unit/ credits**
Credit I	**UNIT I: Microscopy and Electrophoretic Techniques**	**(15)**
	Microscopy- Types, principle, specimen preparation, staining, applications of Phase contrast, Fluorescence, Electron Microscope. Electrophoretic techniques General principles Support Media Electrophoresis of proteins Electrophoresis of nucleic acids Capillary electrophoresis Microchip electrophoresis	
Credit I	**U**NIT II: **Chromatography and Centrifugation**	**(15)**
	Chromatography – basic principles & applications Ion Exchange chromatography. Gel Filtration chromatography. Affinity chromatography. Gas liquid chromatography. High performance liquid chromatography. Centrifugation- Principle & mathematical derivation about centrifugal force – sedimentation rate & sedimentation coefficient. a) Components of centrifuge- types of rotors & centrifuge tubes. b) Types & applications of different types of centrifuges. Ultra Centrifuge – preparative- differential & density gradient centrifugation; analytical type. Care & maintenance of centrifuge.	

Credit I	**UNIT III: Spectroscopy**	**(15)**
	Spectroscopy – *a)* Basic principles of spectroscopy – EMR, photons, types of spectrum, interaction of Light with matter. Principles of photometry - Laws of photometry. Types of spectroscopy – i) Atomic spectroscopy – Atomic emission and absorption spectroscopy. Mass spectroscopy Plasma emission spectroscopy. Spectroscopy – II Molecular spectroscopy U.V./ visible spectroscopy. ii)Infrared & Raman spectroscopy. iii)NMR iv) ESR CD/ORD Spectroscopy. *b)* X – ray spectroscopy – X- ray diffraction	
Credit I	**U**NIT IV: **Protein purification and protein structure determination**	**(15)**
	1) Protein purification Determination of protein concentration Cell disruption and production of initial crude extract c) Fractionation methods – Monitoring of protein purification, Preliminary purification steps. Protein Structure determination Determination of relative molecular mass Amino acid analysis- Primary Structure determination Tertiary Structure determination	

Course outcomes: Student will be able to:

1. Determine bio-analytical techniques useful in research and industries.
2. Demonstrate practical significance of separation techniques of biomolecules.
3. Analyze and determine the techniques related to molecular level analysis.
4. Explain techniques for protein purification and protein structure determination.

REFERENCE –

2. T. Devasena & G. Rajgopal, Techniques in Biochemistry (Ahuja Book Company Pvt.Ltd, 2010)
3. K. Wilson, J. Walker, Principles and Techniques of Biochemistry and Molecular Biology (Cambridge University Press, 3 November 2006)
4. L.Veera Kumari , Bioinstrumentation (MIP Publishers, Chennai, 1 January 2011)
5. Dr. P. Ashokan , Analytical Biochemistry (Chinnaa Publications, 2005)
6. Terrance G. Cooper, Tools in Biochemistry (Wiley India Pvt Ltd, 24 February 2011)
7. B.K.Sharma, Instrumental methods of chemical analysis (Krishna Prakashan Media Pvt Ltd, 1 January 2011)

MAMiT 424 E1 : QUALITY MANAGEMENT IN PHARMACEUTICAL INDUSTRY

Course Objectives: Student will able to-

1. Understand the recent research in drug discovery and development.
2. learn tools and techniques used in antimicrobial testing.
3. Know emerging trends in biopharmaceuticals.
4. Study microbial spoilage of pharmaceutical products.

Credits 4	**SEMESTER-II** **MAMiT 424 E1: QUALITY MANAGEMENT IN PHARMACEUTICAL INDUSTRY**	**No. of hours perunit/ Credits**
Credit I	**UNIT I: Introduction of quality control and assurance**	**(15)**
	Introduction of quality control Definition - Quality control basics. Quality control for: all instruments, clothing's, packing, processing line. Quality control of processes and products: pharmaceutical products Introduction of quality assurance, GMP for: building (premises) for manufacture of drugs, Packaging material, Personnel, hygiene, sanitation, waste and disposal. Quality assurance and regulatory aspect for: import, export, manufacture and sale of drug and formulation clinical and nonclinical testing, animal trials. Records and documents: Records related to products release, Quality review, and Quality audits. Complains and recalls	
Credit I	**UNIT II: Essentials of Analytical Techniques in Pharma Industry**	**(15)**

	A) Media Preparation, Sterilization and Growth Promotion. Guidelines for a) Media Preparation, b) Sterilization and c) Growth Promotion. Environment Monitoring. Introduction, Need for EM, Procedure and Significance. C] Endotoxin Testing Introduction, Gel Clot Method, Kinetic Assays, Medical Devices. D] Antibiotic / Vitamin Assay. General Information, Equipment, Test Organism, Inoculum preparation And Standardization, Antibiotic/Vitamin Standard and Sample Solution Preparation, Growth Media and Additional Test Solutions, Potency Testing –Plate Method and Tube Method. Calculations.	
Credit I	**UNIT III: Other analytical techniques in pharma industry**	**(15)**
	A) Bioburden Estimation of Medical Devices. Definition of Bioburden, FDA Guidelines, Significance F] Microbiological Examination of Non- Sterile Products. Product storage and handling, gowning requirements, Growth promotion and inhibitory properties of the media Suitability of the test method, test procedure, interpretation of the results. G] Preservative Efficacy Testing(PET). Media, Growth promotion of the media, suitability of the counting method in the presence of product, test organisms, preparation of the inoculum, procedure and interpretation	
Credit I	**UNIT IV: Biopharmaceuticals**	**(15)**
	Introduction: Concept and significance of biopharmaceuticals. Regulations and Recommendation Regulatory authorities and their role – the FDA. The concept of Pharmacopoeia – USP, EP, BP and IP. Drug Formulation Studies Drug formulations – carriers and delivery systems. Targeted drug delivery and sustained release. Pharmacokinetics – ADME / Bioavailability studies	

Course Outcomes: Student will be able to: -

1. Explain the basic concepts of quality control.
2. Determine essential analytical techniques for different pharmaceutical products
3. Describe methods used in microbiological examination of non sterile products.
4. Explain the concept of pharmacopoeia.

References: -

1. K. Park (2009), Park's Textbook of Preventive and Social Medicine (20th Edition)– UNIT I.
2. Konrad J. Karczewski, Roxana Daneshjou, Russ B. Altman (2012) Chapter 7. Pharmacogenomics PLOS – UNIT II.
3. Franklin T.J. and Snow G.A., (1975), Biochemistry of Antimicrobial Action, Chapman and Hall, London – UNIT III.
4. Gale E.F., Cundliffe E., Reynolds P.E., Richmond M.H. and Waring M.J., (1972), The molecular basis of antibiotic action, John Wiley and Sons, London –UNIT III.
5. Goldstein A., Aronow L. and Kalman S.M. (1969) Principles of Drug Action, The Basis of Pharmacology, Harper International Edition, New York – UNITIII.
6. Mannfred A. Holliger, (2008) Introduction to Pharmacology, 3rd Edition, CRC Press – UNIT IV.
7. Kokate C. K., Purohit A.P., Gokhale A.B.(2000) Pharmacology, 4th Edition, Nirali Prakashan – UNIT I

MAMiT 424 E2– PHARMACEUTICAL MICROBIOLOGY

Course Objectives: Student should be able to:

1. Know the basic concept of chemotherapeutic agents.
2. Understand the discovery and development of the drug.
3. Study the development of drug,
4. learn the causes and preservation methods of pharmaceutical products.

Credits 4	**MAMIT 424 E2– PHARMACEUTICAL MICROBIOLOGY**	**No. of ho perunit/ credits**
Credit I	**UNIT I: Introduction to chemotherapeutic agents:**	**(15)**
	History and development of chemotherapeutic agent, Properties of antimicrobial agents, iii) Types of chemotherapeutic agents –Synthetic, Semisynthetic, Natural. iv) Antibiotics: Types of antibiotics with their mode of action; antibacterial, antifungal, antiviral, antiprotozoal	
Credit I	**UNIT II: Drug Discovery and Development**	**(15)**
	Introduction Contributions and postulates of Paul Ehrlich Significance of terms - lead optimization, candidate selection Drug Discovery and Design Conventional Process of bioprospecting (medicinal chemistry) Extraction and purification principles, iii) Purification and characterization of bioactive molecules from natural sources Rational Drug Design – Principle (Structure Activity Relationship-SAR) and Tools (applications of High	

	Throughput Screening, Combinatorial Synthesis, Pharmacogenomics) Drug Development i) Preclinical Development – Toxicity Testing: Acute, Sub- acute andChronic. Clinical Development Clinical Trials: Aims, Objectives, Conduct, Phases of Clinical Trials – I,II,III, IV.	
Credit I	**UNIT III: Antibiotic resistance and development of new therapeuti**	**(15)**
	Development of antibiotic resistance, Mechanism of antibiotic resistance, iii) Antimicrobial Peptides: History, properties, sources, mode of action, application. iv) Phage therapy: introduction to phages, lytic cycle, types of phages involved in phage therapy Plant based therapeutic agents.	
Credit I	**UNIT IV: Microbial spoilage and preservation of pharma product**	**(15)**
	i) Microbial contamination spoilage and hazard: Sources of contamination, ii) factors affecting survival and growth, breakdown of active ingredient and general formulations. iii) Principles of sterilizations with respect to pharmaceutical industries. iv) Methods of sterilizations: Steam, dry heat, Radiation, Gaseous and Filtration v) Principles of preservation: objectives of preservation, the ideal preservative, rational development of a product preservative system etc. vi) Antimicrobial preservatives and their properties: antimicrobial activity, factors affecting antimicrobial activity, preservative monographs. vii)Preservative stability and efficacy. viii)Methods of Preservative evaluation and testing	

Course Outcomes:

Student will be able to:-

1. Discuss the types and characters of chemotherapeutic agent.
2. Explain the drug design and drug development method.
3. Describe the concept of drug resistance and development of new drug.
4. Compare various methods of preservations of pharmaceutical products.

References:-

1. Pharmaceutical Microbiology Manual (PMM), United States Food and DrugAdministration (USFDA), ORA.007, Version 1.2, 2014.
2. Indian Pharmacopoeia (IP), Volume II (P-Z, Reference Spectra and Appendices), Ministryof Health and Family Welfare, Government of India, 1996.
3. Manohar A. Potdar, Pharmaceutical Quality Assurance, 2nd Edition, NiraliPrakashan,2007.(Unit III)
4. Baird R.M., Hodges N.A.,DenyerS.P.,Handbook of Microbiological Quality Control inPharmaceuticals and Medical Devices,CRC press, 2000(Unit III, IV)

MAMIT 425: RESEARCH PROJECT

Credits 4	**MAMIT 425: RESEARCH PROJECT**	**No. of hou 60**

M.Sc.Part-I Semester -II MAMiP 426- Practical Course

(Based on MAMiT 421,422,423 courses)

Course objectives: Student should be able to -

1. Study separation of biomolecules using chromatography techniques
2. learn quantitative estimation of hydrocarbons, pesticides, organic solvents methane by gas chromatography.
3. study the method of preparation of buffers of various pH
4. Study preparation of immobilized cells of yeast cells and determination of invertase

Credit 2	**MAMiP 426 Practical Course (LAB-I)**	**No. of hou -(60)**
	Separation and identification of amino acid mixture by 2D paper chromatography. Separation and identification of amino acid mixture by TLC. Preparation of immobilized cells of yeast cells and determination of invertase activity. Study of effect of gel concentration on immobilized enzyme activity. Determination of capacity of ion exchange resin [Dowex – 50]. Determination of molar extinction coefficient. Preparation of Phosphate/Acetate/Carbonate buffers. Isolation of cellulase producers from soil. Titration curve of glycine. Study of organisms subjected to nutritional stress (Carbon) Detection of Siderophore produced by Pseudomonas spp. Assay of Protease and Lipase enzymes Determination of mutation rate in bacteria.	

	Fluctuation test. Testing of chemical for mutagenicity using Ames test. Demonstration of PCR/DNA sequencer/Fermenter. Separation of serum protein by horizontal submerged gel electrophoresis. Separation of DNA by agarose gel electrophoresis Laboratory production of alkaline protease by solid state fermentation using bacteria. Protein Assay by tyrosine curve. Laboratory production of citric acid by solid state fermentation using fungi and its estimation.	

Course outcomes: Student will be able to**: -**

1. Separate and identify the biomolecules from mixtures using chromatography techniques
2. Perform quantitative estimation of hydrocarbons, pesticides, organic solvents , methane by gas chromatography.
3. Prepare various buffers like phosphate, acetate and carbonate.
4. Apply the technique for quantitative estimation of hydrocarbons.

REFERENCE:

1) D.K Maheshwari, R.C.Dubey Practical microbiology – (S. Chand Publishing, 2021) 4.Rashmi A. Joshi A, textbook of practical biochemistry (B.Jain Large Print, 1 A pril 2006)
2) David T. Plummeran introduction to practical biochemistry- 3rd edition,(McGraw Hill Education, 1 July 2017)
3) William M. O'Leary Practical handbook of microbiology (CRC Press, January 1, 1674)
4) D.K Maheshwari, R.C.Dubey Practical microbiology – (S. Chand Publishing, 2021)
5) Rashmi A. Joshi A, textbook of practical biochemistry (B.Jain Large Print, 1 April 2006)
6) N. Gurumani, Scientific thesis writing and paper presentation, (MJP Publishers, Chennai, 2010).
7) C. R. Kothari, Research Methodology; Methods and Techniques,2ndEd, (New Age International Publishers, New Delhi, 2004).
8) David T. Plummer An introduction to practical biochemistry- 3rd edition, (McGraw Hill Education, 1 July 2017).
9) William M. O'Leary Practical handbook of microbiology (CRC Press, January 1, 1674