MGM UNIVERSITY, CHH. SAMBHAJINAGAR

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Basic & Applied Sciences

Post Graduate (PG) Programme

Industrial Microbiology - CURRICULUM

w. e. f. Academic Year 2023-24

M.Sc. Industrial Microbiology

CURRICULUM

Prepared By
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Submitted By
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Approved By
Board of Studies

Illustrative Credit distribution structure for Two Years/ One Year PG
M.Sc. Post Graduation Programme (M.Sc. IM)

Year	Level	Sem.	Major		RM	OJT/ FP	RP	Cum. Cr.	Degree
			Mandatory	Electives					
I	6	I	13 (3*3 +2*2)	4	4			21	PG Diploma (after 3 Yr Degree)
		II	14 (3*4 +2)	4		4		22	
Cum. Cr. For PG Diploma			**27**	**8**	**4**	**4**	**-**	**43**	
Exit option: PG Diploma (44 Credits) after Three Year UG Degree									
II	6.5	III	12 (2*4 + 2*2)	4			4	20	
		IV	10 (1*10)	4			8	22	
Cum. Cr. for 1 Yr PG Degree			**22**	**8**	**4**		**12**	**42**	**PG Degree After 3-Yr UG Or**
Cum. Cr. for 2 Yr PG Degree			**49**	**16**	**4**	**4**	**12**	**85**	**PG Degree after 4-Yr UG**
2 Years-4 Sem. PG Degree (85-credits) after Three Year UG Degree or 1 Year - 2 Sem PG Degree (42- credits) after Four Year UG Degree									

Appendix-2023																			
PROGRAMME: M.Sc. Industrial Microbiology																			
Semester I																			
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**				**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MIMML101**	**Molecular Cell Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML102	**Microbial Physiology and Metabolism**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML103	**Biochemistry**	**Theory**	**Major Mandatory**	2	-	2	10	10	10	-	20	-	50	-	8	-	20
	MIMML104	**Fermentation Technology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
		Research Methodology	**Theory**	**RM**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MIMMJ105	**Mini Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30		20	50	-	-	8	20
	MIMEP106 **MIMEP107**	**1. Bio Lab (Practical)** **2. Microbial Diversity Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	0	20	50	-	-	8	20
	MIMEP108 **MIMEP109**	**1. Microbiology Lab** **2. Industrial important microbes lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30		20	50	-	-	8	20
		Total (L-P) Hrs / week = 27			**15**	**12**	**21**	**90**	**90**	**90**	**90**	**180**	**60**	**600**		**72**	**24**	**240**

Semester II (M.Sc. IM)																		
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MIMML110**	**Bioremediation and Waste Treatment**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML111	**Downstream Processing**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML112	**Strain Design and Strain Improvement**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML113	**Genomics and Bioinformatics**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMEP114 **MIMEP115**	**1. Microbial Lab** **2. Biotechnique Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MIMEP116 **MIMEP117**	**1. Genomics Exploration Laboratory** **2. Bioinformatics Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MIMMJ118	**Micro Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MIFPJ119	**Field Project**	**Practical**	**FP**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
		Total (L-P) Hrs / week = 32			**12**	**20**	**22**	**80**	**80**	**80**	**150**	**160**	**100**	**650**		**64**	**40**	**260**

Level 6.0 Award of PG Diploma (44 Credits) after Three Year UG Degree

Semester III (M.Sc. IM)																			
Level	**Course code***	**Course Title**	**Type**	**Category**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**		**Total**		**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**		**Internal**	**ESE**	**PR**	**Total**
6.5	**MIMML201**	**Industrial Microbiology Case Studies**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MIMML202	**Wine, Brewing and Biofuel**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MIMML203	**Industrial Microbiology seminar series**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MIMEP204 **MIMEP205**	**1. Industrial Microbiology Lab** **2. Food and Dairy microbiology practical**	**Practical**	**Major Elective**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
	MIRPJ206	**Major Project**	**Practical**	**RP**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
		Total (L-P) Hrs / week = 28			**12**	**16**	**20**	**60**	**60**	**60**	**120**	**120**	**80**	**500**	-	**48**	**32**	**200**

Semester IV (M.Sc. IM)																		
Level	**Course code***	**Course Title**	**Type**	**Category**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**				**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.5	**MIMEL207** **MIMEL208**	**1. Ethics/ Biosafety/ IPR** **2. Quality control and Assurance**	**Theory**	**Major Elective**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MIJTI209	**On Job Training**	**OJT**	**Major Mandatory**	-	20	10	-	-	-	200	-	50	250	-	-	20	50
	MIRPJ210	**Research Project**	**RP**	**RP**	-	16	8	-	-	-	150	-	50	200	-	-	20	50
		Total (L-P) Hrs / week = 40			**4**	**36**	**22**	**20**	**20**	**20**	**350**	**40**	**100**	**550**	**-**	**16**	**40**	**140**

Level 6.5 Award of PG Degree after Three Years UG Degree with 86 credits OR Four Years UG Degree with 42 credits

MGM UNIVERSITY, CHH. SAMBHAJINAGAR

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Basic & Applied Sciences

Post Graduate (PG) Programme

INDUSTRIAL MICROBIOLOGY - CURRICULUM

w. e. f. Academic Year 2023-24

M.Sc. Industrial Microbiology

SEMESTER-(I)

CURRICULUM

Appendix-2023																			
PROGRAMME: M.Sc. Industrial Microbiology																			
Semester I																			
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**				
								Internal				**External**				**External**			
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**	
6.0	**MIMML101**	**Molecular Cell Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40	
	MIMML102	**Microbial Physiology and Metabolism**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40	
	MIMML103	**Biochemistry**	**Theory**	**Major Mandatory**	2	-	2	10	10	10	-	20	-	50	-	8	-	20	
	MIMML104	**Fermentation Technology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40	
		Research Methodology	**Theory**	**RM**	4	-	4	20	20	20	-	40	-	100	-	16	-	40	
	MIMMJ105	**Mini Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30		20	50	-	-	8	20	
	MIMEP106 **MIMEP107**	**1. Bio Lab (Practical)** **2. Microbial Diversity Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	0	20	50	-	-	8	20	
	MIMEP108 **MIMEP109**	**1. Microbiology Lab** **2. Industrial important microbes lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30		20	50	-	-	8	20	
		Total (L-P) Hrs / week = 27			**15**	**12**	**21**	**90**	**90**	**90**	**90**	**180**	**60**	**600**		**72**	**24**	**240**	

MOLECULAR CELL BIOLOGY

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science **Institute:** Institute of Biosciences and Tech. **Degree:** M.Sc. Industrial Microbiology (PG) **Course Unit Code:** MIMML-101 **Course Title:** Molecular Cell Biology **Credits allocated:** 3+0(3Theory+0 Practical) **Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs weekly **Recommended Year/Semester:** Industrial Microbiology Masters of Science, Year 1/Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the Principal. The approved courses must be mentioned in the roster form.
Candidate should pass in Under Graduate life Sciences.

Learning Outcomes: 1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles 2. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.

Objective:1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles 2. Students will understand how these cellular components are used to generate and utilize energy in cells

Detailed Syllabus

Total Lectures = 45

UNIT 1: Cell Structure and Function (9 Lectures)

Subtopics:

Overview of cell structure and organization

Cell membrane structure and transport mechanisms

Cytoskeleton and cell motility

Cell cycle and cell division

UNIT 2: Cellular Signaling and Communication (9 Lectures)

Subtopics:

Introduction to cell signaling

Signal transduction pathways and second messengers

Receptor-mediated signaling

Intracellular signaling networks

UNIT 3: Gene Expression and Regulation (9 Lectures)

Subtopics:

DNA structure and packaging

Transcription and RNA processing

Translation and protein synthesis

Regulation of gene expression

UNIT 4: Cell Death and Cell Senescence (9 Lectures)

Subtopics:

Apoptosis and programmed cell death

Autophagy and cell survival mechanisms

Cellular senescence and aging

UNIT 5: Cell-Cell Interactions and Tissue Homeostasis (9 Lectures)

Subtopics:

Cell adhesion molecules and cell junctions

Extracellular matrix and cell-matrix interactions

Cell communication in tissue development and repair

Stem cells and tissue regeneration

SUGGESTED READINGS / REFERENCE BOOKS/ TEXTBOOKS

1. Molecular Biology of Gene by Watson, Baker, Bell

2. Lodish, et al. Molecular Cell Biology. 5th ed. New York,NY: W.H. FreemanandCompany, 2003. ISBN: 9780716743668.

3. Hardin, J, and Bertoni, G.P. 2015. Becker's World of the Cell, 9th edition, Pearson

4. Bruce Alberts, et al. Molecular biology of the cell. Garland Science, 2015. 6th edition.

5. Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts, and Walter. 2014. EssentialCellBiology 4th ed. Garland Science. ISBN: 978-0-8153-4454-4.

MICROBIAL PHYSIOLOGY AND METABOLISM

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Industrial Microbiology (PG)

Course Unit Code: MIMML-102 **Course Title:** Microbial Physiology,and Metabolism

Credits allocated: 3(3Theory+0 Practical) **Level of Study:** PG

Mode of Delivery, Planned Learning Activities and Teaching Method: Lecture 3 hrs weekly

Recommended Year /Semester: Industrial Microbiology M.Sc. 1 Year / Semester I

Prerequisites For Registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidate should pass in under graduate Life Sciences.

Learning Outcomes: Microbes are ubiquitous and omnipresent. Understanding Microbes Physiology &their Metabolism provide insight knowledge on their sources of energy &its utilization as they are tiny factories for the production of high-value low-volume products to low-value high-volume products which are its primary & secondary metabolites. Primary metabolites are typically formed during the growth phase as a result of energy metabolism and are deemed essential for proper growth. And, many of the identified microbes' secondary metabolites have a role in ecological function. Microbes have a diverse metabolic activity which not observed in any other group of organisms. Thus, it is critical understand Microbe's physiology and metabolism, to manipulated them, in order to enhance their growth or to product desired products of commercial value,

Objectives: The syllabus is designed keeping in mind recent development in Microbial Physiology & Metabolism. Students will understand to learn and update their knowledge on this field. Students will gain an understanding of the principles and mechanisms underlying microbial physiology and how microorganisms adapt to their environment.

Detailed Syllabus

Theory

Unit 1: Introduction to Microbial Physiology 9 Lecture

Introduction to Microbial Physiology: Definition and scope of microbial physiology. Importance of studying microbial physiology. Microbial Cell Structure and Function: Prokaryotic and eukaryotic cell. Cell membrane structure and function. Cell wall composition and significance. Organelles and their roles in microbial physiology.

Unit 2: Microbial Growth and Reproduction: 9 Lecture

Microbial Growth and Reproduction: Bacterial growth phases (lag, exponential, stationary, death). Measurement of microbial growth (direct and indirect methods). Factors influencing microbial growth (temperature, pH, oxygen, etc.). Microbial reproduction (binary fission, budding, sporulation). Nutrient Uptake and Transport: Nutritional requirements of microorganisms. Mechanisms of nutrient uptake (active and passive transport). Transport proteins and their role in nutrient acquisition.

Unit 3: Metabolism and Energy Production: **9 Lecture**

Metabolism and Energy Production: Overview of microbial metabolism (catabolism and anabolism): Glycolysis and the tricarboxylic acid (TCA) cycle, Electron transport chain and oxidative phosphorylation, Fermentation pathways and alternative energy sources. Enzymes and Enzyme Regulation: Enzyme structure, function, and classification, Enzyme kinetics and mechanisms, Regulation of enzyme activity (allosteric regulation, feedback inhibition).

Unit 4: Microbial Adaptation and Stress Response: 9 Lecture

Microbial Adaptation and Stress Response: Microbial response to changes in temperature, pH, and osmolarity. Environmental Adaptations of Microorganisms: Microbial adaptations to extreme environments (thermophiles, halophiles), Psychrophiles and their cold adaptation mechanisms, Microbes in anaerobic environments and oxygen tolerance.

Unit 5 Signal Transduction and Gene Regulation: 9 Lecture

Signal Transduction and Gene Regulation: Signaling molecules and signal transduction pathways, Two-component systems and quorum sensing, Transcriptional regulation (induction, repression,

operons). Recent research trends in microbial physiology: an overview.

Suggested readings/ reference books/ text books

1. R. M. Atlas, *Microbiology: Fundamentals and Applications,* 2nd Edition, MacMillan Publishing Company, New York, 1989.
2. E. E. Conn and P. K.Stumpf, *Outlines of Biochemistry*, John Wiley & Sons, 1976.
3. J. R. Gallon and A. E. Chaplin, *An Introduction to Nitrogen Fixation*, Cassell Education,Ltd.,1987
4. G. Gottschalk, *Bacterial Metabolism*,2nd edition, Springer Verlag, 1986
5. A. Lehninger, *Biochemistry*.WorthPubl, 1982.
6. A. G. Moat and J. W.Foster, *Microbial Physiology*. John Wiley and Sons, 2002
7. M. T .Madigan, K. S. Bender, D. H. Buckley, W. M. Sattley and D. A. Stahl, *Brock Biology of Microorganisms*, 15th Global Edn., Pearson-Benjamin Cummings, 2017.
8. B.H. Kim and G.M. Gadd, *Bacterial Physiology and Metabolism*, Cambridge University Press, 2008.
9. L. Snyder and W. Champness, *Molecular Genetics of Bacteria*, 3rd edition, American Society for Microbiology, Washington, D. C., 2007.

   J. Willey, L. Sherwood, C. Woolverton, *Microbiology*, Prescott's, 10th Edition, McGraw-Hill, New York City, NY. 2017

BIOCHEMISTRY

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science
Institute: Institute of Biosciences & Tech. **Degree:** M.Sc**.** Industrial Microbiology**Course Unit Code:** MIMML-103 **Course Title:** Biochemistry
Credits allocated: 2(2Theory +0 Practical) **Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 2 hrs / weekly

Recommended Year /Semester: Industrial Microbiology Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approvedcourses must be mentioned in the roster form.
Candidate should pass in Under graduate Life Sciences.

Learning Outcomes: Students will be able to understand microbial Biochemistry-Carbohydrate, Cell membrane and transport, Energy production in bacteria, Enzyme-Classification and nomenclature and Photosynthetic bacteria and cyanobacteria interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities.

Objective: Microbial Physiology is the study of structure, function, energy metabolism, growth and regulatory mechanisms of microorganisms. In this course, the students will learn about the metabolic diversity exhibited by microorganisms, their thermodynamics and regulatory networks that support their survival and growth

COURSE
CONTENTS
THEORY

Unit 1: Structures & Functions of Proteins & Enzymes 7 Lectures

Amino acids & Peptides, Proteins: Determination of Primary Structure, Proteins: Higher orders of structure, Proteins: Myoglobin & Hemoglobin, Enzymes: Mechanism of Action, Enzymes: Kinetics, Enzymes: Regulation of Activities, Bioinformatics & Computational biology **Bioenergetics & The Metabolism of Carbohydrates & Lipids** Bioenergetics: The role of ATP, Biologic Oxidation, The Respiratory Chain & Oxidative Phosphorylation, Carbohydrates of Physiologic Significance, Lipids of Physiologic Significance, Overview of

Metabolism & the provision of metabolic Fuels, The Citric acid cycle: The catabolism of Acetyl- Co A, Glycolysis & the Oxidation of Pyruvate, Metabolism of Glycogen, Gluconeogenesis & the Control of blood glucose, The pentose phosphatepathway & otherpathways of hexose metabolism

Unit 2: Metabolism of Proteins & Amino Acids 8 Lecture

Biosynthesis of the nutritionally Nonessential amino acids, Catabolism of Proteins & of amino acid nitrogen, Catabolism of the carbon skeletons of amino acids, Conversion of Amino Acidsto Specialized products, Polypyrenes & Bile pigments.

Unit 3: Structure, Function & Replication of Informational Macromolecules

7 Lecture

Nucleotides, Metabolism of Purine & Pyrimidine nucleotides, Nucleic acid, Structure & function, Nucleic acid structure & function, DNA Organization, Replication, & Repair, RNAsynthesis, Processing & Modification, Protein Synthesis & genetic code, Regulation of geneexpression, Molecular genetics, Recombinant DNA, & Genomic Technology

Unit 4: Biochemistry of Extracellular & Intracellular Communication 8 Lecture

Membranes: Structure & Function, The Diversity of Endocrine system, hormone action & Signal Transduction, Nutrition, Digestion & Absorption, Micronutrients: Vitamins & Minerals, Free radicals and Antioxidant Nutrients

Suggested readings / reference books/ text books

1. Berg, J.M., Stryer, L (2002) *Biochemistry* W.H Freeman&Company
2. Nelson, D.L., Cox, M (2008) *Lehninger's Principles of Biochemistry* Mac Millan
3. Voet, D and Voet, J.G (2010) *Biochemistry* 4th edition Wiley
4. Jain, J. L (2005) *Fundamentals of Biochemistry* 6 th edition S.Chand&Co
5. Deb, A.C(2001*) Fundamentals of Biochemistry* New Central Book Agency(P) Ltd
6. Pelczar, M.J., Chan,E.C.S and Kraig (1977) *Microbiology* Mc Graw-Hill
7. Talaro, K.P., and Talaro A (2004) *Foundations of Microbiology* 5 th edition Mc Graw-Hill
8. Aneja, K.R., Jain, P. and Aneja, R (2008) *Text book of Basic and Applied Microbiology* NewAge International.

FERMENTATION TECHNOLOGY

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Industrial Microbiology (PG)

Course Unit Code: MIMML104 **Course Unit Title: Fermentation Technology**

Credits allocated: 3+0(3 Theory +0 Practical) **Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs weekly

Recommended Year /Semester: 1 Year / Semester

Prerequisites:

Microbiology and Biotechnology

Learning outcomes: 1. Will have gained knowledge on industrially important microbes and recent developments in fermentation processes. 2. Understands the concept of sterilization methods. 3.Attains knowledge about industrial biotechnology. 4. Learns about the Bioprocess instrumentation and control parameters and Downstream processing. 5.Acquires knowledge about various industrially relevant microbial products and their production process

Objectives: 1. Learning of microbiology concepts toward the exploitation of microbial population for industrial and human benefits. 2. The strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant microbial products.

Detailed Syllabus

Theory

Unit I: An overview of fermentation **9 Lecture**

An overview of fermentation - current status of fermentation industry. Fermentor design, high performance bioreactors, mass and energy transfer76

in bioreactors. Instrumentation and control in fermentors – on line measurements systems, computer application.

Unit II Media for microbial fermentation **9 Lecture**

Media for microbial fermentation; Criteria in media formulation. An overview of downstream Processing.

Unit III Strategies for Isolation for industrial Microbes **9 Lecture**

New strategies for isolation of industrially important microbes and their genetic manipulations; Microbial production of health care products. Antibiotic fermentation research; steroid transformation.

Unit IV Development on production of metabolites **9 Lecture**

Recent developments on production of primary and secondary metabolites, Treatment of biological wastes, microbial inoculants and enzymes for waste treatment

Unit V Yest Technology & Microbial Products **9 Lecture**

Yeast technology – classification, genetics, strain improvement for brewing, baking and distilleries and topics of current interest in fermentations.

Microbial products: e.g., Fermented milk products, probiotics, malt beverages, wines, distilled liquors, recombinant biomolecules and therapeutic proteins, antibodies, vaccines production, DNA based vaccines, antibody production, therapeutic enzymes, industrially important enzymes and green fuel production, Development of bio-pesticides and bio-fertilizers. Basic objective for successful economically viable fermentation process, cost breakdown for well-established fermentation processes, market potential of the products, cost aspects of various stages in the process's development including effluent treatment

Suggested Reading/ Reference Books/ Text Books

1. P. Stanbury, A. Whitaker and S. Hall, *Principles of Fermentation Technology*, 3 rd edition,Butterworth-Heinemann(2016).
2. M. L. Shuler and F. Kargi, *Bioprocess Engineering: Basic Concepts*, 2nd edition, PearsonEducation India.(2015).
3. N. Okafor, *Modern Industrial Microbiology & Biotechnology*, 1st edition, CRC Press,USA(2007).
4. E. M. T . El-Mansi, C. F. Bryce, A. L. Demain and A. R. Allman, *FermentationMicrobiology and Biotechnology*, 3rd edition, CRC Press(2012).
5. N. Glazer and H. Nikaido, *Microbial Biotechnology: Fundamentals of AppliedMicrobiology*, 2nd edition, Cambridge University Press(2007).

MINI PROJECT

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Industrial Microbiology(PG)

Course Unit code: MIMMJ105 **Course Unit Title:** Mini Project

Credits allocated: 0+2 (0 theory + 2 practical) **Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 6hrs weekly **Recommended Year /Semester:** M.Sc. Industrial Microbiology, Year 1/Semester I **Prerequisites for registration:** Registration of a student in various courses in consultationwith the respective course teacher and Adviser and acceptance by the principal. The approvedcourses must be mentioned in the roster form.

Learning Outcome:

1. Students will be able to practice acquired knowledge within the chosen area of technologyfor project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensiveand systematic approach.

Objective:

A research aim is a broad statement indicating the general purpose of your research project. Students can gain a knowledge of various techniques

Thrust Area of Project:

1. Antimicrobial resistance
2. Host Microbe interactions (Plants, Animals, Humans, etc)
3. Microbial genomics
4. Microbial analysis
5. Bioremediaion
6. Microbial ecology
7. Bioprospecting (Biofuel, Biofertilizer, etc)
8. Microbial pathogenesis
9. mRNA technology
10. Synthetic biology
11. Cyanobacterial and algal biotechnology

12. Microbial biosynthesis
13. Bioprocess Optimization and modelling
14. Industrial microbiology and sustainability/ Sustainability and circular economy
15. Novel enzymes and bio catalysis
16. Microbiome engineering for bioprocessing
17. Biofilm engineering and application
18. Process analytics and big data
19. Bioprocess intensification and miniaturization

BIO LAB (Practical)

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Industrial Microbiology

(PG)**Course Unit Code:** MIMEP106 **Course Unit Title:** Bio lab

Credits allocated: 0+2 (0 Theory + 2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester I

Learning Outcome:

Students will able to gain the knowledge about Bacterial DNA, Concentration of Protein in various sample.

Objective: Students can able to understand various techniques. They can handle various instruments

Practical list:

1. Isolation of Genomic DNA from Bacterial Cells
2. Isolation of Plasmid.
3. Quantification of bacterial DNA
4. PCR of Bacterial DNA.
5. CsCl-Density Separation of DNA
6. Mitosis in Onion Root Tip
7. Preparation of blood smear and differential staining of blood cells Isolation of chloroplasts.
8. Qualitative Tests for carbohydrate
9. Qualitative Tests for amino acid
10. Estimation of reducing sugar by the DNSA
11. Determining Blood Sugar by Nelson and Somogyi's Method
12. Estimation of Protein by the Biuret Method
13. Estimation of Protein by the FC-Method
14. Protein Assay by Bradford Method.
15. Estimation of DNA by the Diphenylamine Method
16. Estimation of RNA by the Orcinol Method
17. Estimation of Vitamin C

18. Separation of Protein Standards: SDS-PAGE
19. Enzyme linked immune sorbent assay.
20. Separation of amino acids by paper chromatography and paper electrophoresis
21. Determination of iodine value of oil.
22. Separation of sugar by silica gel TLC, Cellulose TLC.

Microbial Diversity lab

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Industrial Microbiology

(PG)**Course Unit Code:** MIMEP107 **Course Unit Title:** Microbial Diversity Lab

Credits allocated: 0+2 (0 Theory + 2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester I

Learning Outcome:

Compare microbial communities from different environments Identify factors that affect microbial growth Isolate microorganisms on agar plates Describe the appearance of, and quantify, microbial colonies Explain the mechanisms and effects of antimicrobials

Objective:

Compare microbial communities from different environments Identify factors that affect microbial growth Isolate microorganisms on agar plates Describe the appearance of, and quantify, microbial colonies Explain the mechanisms and effects of antimicrobials

Practical list:

1. Microbiology Good Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Isolation of bacteria and study morphology of different bacteria.
5. Gram Staining and Describe bacterial structure: colony morphology, cell shape and state of aggregation.
6. Preparation of culture media for Fungi cultivation
7. Isolation of Fungi and study morphology of different fungi.
8. Preparation of culture media for actinomycete cultivation
9. Isolation of actinomycetes and study morphology of different actinomycetes.
10. Describe a scenario for succession of bacterial communities in aging milk, relating this to changes in environmental conditions such as pH and nutrient availability.
11. Describe a scenario for succession of fungal communities in aging milk, relating this to changes in environmental conditions such as pH and nutrient availability.

12. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
13. Demonstration of the presence of microflora present in water.
14. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts
15. Study of Spirogyra and Chlamydomonas, Volvox using permanent Mounts
16. Study of the following protozoans using permanent mounts/photographs: Amoeba, Paramecium, Plasmodium
17. Microbial examination of vegetables
18. Select different area for microbial diversity.
19. A visit to any educational institute/Microbial lab to see microbial Diversity.
20. Study Research Paper.

Reference:

1. Microbial Diversity: Form and Function in Prokaryotes, Oladele Ogunseitan 19 October 2004
2. Arrieta, J.M., M.G. Weinbauer, and G.J. Herndl. 2000. Interspecific variability in sensitivity to UV radiation and subsequent recovery in selected isolates of marine bacteria. Applied and Environmental Microbiology.

MICROBIOLOGY LAB

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M. Sc. Industrial Microbiology (PG)

Course Unit Code: MIMEP108 **Course Unit Title:** Microbiology Lab

Credits allocated: 0+2 (0 Theory + 2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrsweekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester I

Learning Objective:

The safe methods for isolation, subculture, and maintenance of bacterial, fungal, and viral specimens. An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal physiology. An understanding of bacterial, fungal, and viral structure and metabolism as it relates to identification and contrsol of pathogenic organisms. An understanding of the uses of various media and testing protocols with focus on clinical applications.

Objective:

- The microbiology laboratory provides the content expertise and leadership in infectious disease diagnosis, pathogen discovery, antibiogram, biosafety, and biosecurity areas. As such, the microbiology laboratory partners with any discipline or person in the health care system that requires their expertise to address current and changing needs.

Practical List:

1. Isolation of bacteria from soil
2. Isolation of fungi from soil
3. Lactophenol cotton blue staining.
4. Isolation of Micro-organism from Air, Water
5. Microscopic slide preparation- Simple staining- Positive
6. Negative staining
7. Gram staining
8. To understand & study biochemical activities of microorganisms: Amylase production test
9. Carbohydrate fermentation test.
10. Cellulose production test
11. Casein hydrolysis
12. Hydrolysis of gelatine test

13. IMViC test
14. Growth Cure of bacteria
15. Isolation of casein from Milk Sample.
16. Microbiological Examination of Milk.
17. Microbial analysis of food items.
18. Fermentative production of ethanol.
19. To extract alpha amylase from *Bacillus subtitles*
20. Effect of temperature on growth of bacteria or fungi
21. Effect of pH on growth of bacteria or fungi
22. Growth of microorganisms on various carbon sources.
23. Growth of microorganisms on various nitrogen sources.
24. Use of P sources for studying P uptake by microorganisms.
25. Use of K sources for studying K uptake by microorganisms.
26. Reading Research Paper

Reference:

a. MICROBIOLOGY: A LABORATORY MANUAL, 10TH EDN by James Cappuccino and Natalie Sherman, 2014.
b. Benson's Microbiological Applications: Laboratory Manual in General Microbiology by Alfred E. Brown, Heidi R. Smith, 2016.

Industrial Important Microbes lab

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M. Sc. Industrial Microbiology (PG)

Course Unit Code: MIMEP109 **Course Unit Title:** Industrial Important Microbes lab.

Credits allocated: 0+2 (0 Theory + 2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester I

Learning Outcome:

Students will be able to know the microorganism used in industry.

Lists the microorganisms used in industry. Will be able to explain the production of industrial products from microorganisms with fermentation. Students will be able to list the fermentation media.

Objective: Industrial Microbiology is a branch of applied microbiology in which microorganisms are used for the production of important substances, such as antibiotics, food products, enzymes, amino acid

Practical List:

1. Isolation and purification of industrially important microorganisms from environmental samples or commercial sources.
2. Morphological and biochemical characterization of selected microbes using staining techniques and biochemical tests.
3. Molecular identification of microorganisms using PCR-based methods and DNA sequencing
4. Determination of growth parameters (lag phase, exponential phase, stationary phase) for industrially relevant microorganisms using growth curves
5. Measurement of growth rates and biomass accumulation under varying culture conditions (temperature, pH, nutrient availability)
6. Screening for enzyme-producing microorganisms using selective media and indicator substrates
7. Quantitative estimation of enzyme activity (e.g., amylase, protease, lipase) using spectrophotometric or titration-based assays
8. Optimization of fermentation conditions (temperature, pH, carbon and nitrogen sources) for enhanced enzyme production
9. Design and execution of small-scale fermentations using industrially important microorganisms

10. Monitoring and control of fermentation parameters (aeration, agitation, temperature) to optimize growth and product formation
11. Analysis of fermentation samples for biomass, metabolites, and product titers
12. Investigation of metabolic pathways involved in the production of specific compounds (e.g., biofuels, organic acids, antibiotics)
13. Utilization of genetic and metabolic engineering approaches to enhance the productivity of target compounds
14. Analysis of metabolic intermediates and byproducts using chromatographic techniques (HPLC, GC-MS)
15. Operation of bench-scale bioreactors to simulate industrial fermentation conditions
16. Monitoring and control of process parameters (pH, dissolved oxygen, agitation, feeding) during bioreactor operation
17. Evaluation of bioreactor performance, including product yield, productivity, and biomass growth
18. Purification and separation of microbial products using various techniques such as filtration, chromatography, and precipitation
19. Analysis of purity, yield, and recovery of target compounds using analytical methods (HPLC, SDS-PAGE, ELISA)
20. Characterization of microbial products through physicochemical and biological assays
21. Evaluation of microbial strains for their ability to degrade specific pollutants or environmental contaminants
22. Microbial growth assessment and measurement of degradation rates through quantification of target pollutants
23. Optimization of environmental conditions (pH, temperature, nutrient availability) for enhanced biodegradation activity
24. Construction of synthetic microbial consortia or co-cultures for targeted biotransformations or bioproduction
25. Monitoring of microbial interactions and metabolic exchange within the consortia
26. Evaluation of consortia performance compared to individual strains
27. Implementation of analytical techniques for real-time monitoring of critical process parameters (e.g., dissolved oxygen, pH, nutrient concentration)
28. Utilization of statistical process control tools for process optimization and troubleshooting
29. Integration of online sensors and automation systems for improved process monitoring and control
30. Microbial fermentations for the production and estimation (qualitative and quantitative) of : Enzymes: Amylase and Protease
31. Microbial fermentations for the production and estimation (qualitative and quantitative) Amino acid: Glutamic acid
32. Microbial fermentations for the production and estimation (qualitative and quantitative) of : Organic acid: Citric acid.

Reference:

1. An Introduction to Industrial Microbiology by Sivakumaar P.K, 2010.
2. Industrial Microbiology by L.E.J.D Casida,2019.
3. INDUSTRIAL MICROBIOLOGY:AN INTRODUCTION by waites M.J,2002.

Research Methodology

University: MGM University, Chh. Sambhajin | **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. | **Degree: M.Sc.** IM (PG)

Course Unit Code: | **Course Unit Title:** Research Methodology

Credits allocated: 4+0 | **Level of Study: PG**

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: M.Sc. Plant Breeding & Molecular Genetics Year I/ Semester I

Objectives:

- To get introduced to research philosophy and process in general
- To be able to formulate the problem statement and research plan for theproblemunderinvestigation
- To be able to apply various numerical/ quantitative techniques for data analysis
- To be able to communicate the research findings effectively

COURSE CONTENTS

THEORY (Total Lectures = 60)

Unit I: (12 Lectures)

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Unit II: (12 Lectures)

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research

Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Unit III: (12 Lectures)

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling:Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method**.**

Unit IV: (12 Lectures)

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests**.**

Unit V: (12 Lectures)

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Suggested Readings

1. 'Management Research Methodology' by K.N. Krishnaswamy, Appa Iyer Sivakumar & M. Mathirajan, Person Education.
2. 'Research Methodology. G.C. Ramamurthy, Dream Tech Press, New Delhi
3. 'Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, 2nd Edition
4. 'Research Methodology: An Introduction for Science and Engineering Students', byStuart Melville and Wayne Goddard

5. ‘Research Methodology: An Introduction’ by Wayne Goddard and Stuart Melville ‘Research Methodology: Methods and Techniques’, by Dr. C.R. Kothari, New AgeInternational Publisher

MGM UNIVERSITY, CHH. SAMBHAJINAGAR

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Basic & Applied Sciences

Post Graduate (PG) Programme

INDUSTRIAL MICROBIOLOGY - CURRICULUM

w. e. f. Academic Year 2023-24

M.Sc. Industrial Microbiology

SEMESTER-(II)

CURRICULUM

Semester II (M.Sc. IM)																		
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MIMML110**	**Bioremediation and Waste Treatment**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML111	**Downstream Processing**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML112	**Strain Design and Strain Improvement**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMML113	**Genomics and Bioinformatics**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MIMEP114 **MIMEP115**	**1. Microbial Lab** **2. Biotechnique Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MIMEP116 **MIMEP117**	**1. Genomics Exploration Laboratory** **2.Bioinformatics Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MIMMJ118	**Micro Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MIFPJ119	**Field Project**	**Practical**	**FP**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
		Total (L-P) Hrs / week = 32			**12**	**20**	**22**	**80**	**80**	**80**	**150**	**160**	**100**	**650**		**64**	**40**	**260**

Level 6.0 Award of PG Diploma (44 Credits) after Three Year UG Degree

BIOREMEDIATION AND WASTE TREATMENT

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences & Tech. **Degree:** M. Sc. Industrial Microbiology (PG)

Course Code: MIMML110 **Course Title:** Bioremediation and waste treatment

Credits allocated: 3+0(3Theory+0 Practical) **Level of Study:** PG

Mode of Delivery, Planned Learning Activities &Teaching Method: Lecture 3 hrs / weekly

Recommended Year /Semester: Industrial Microbiology, M. Sc. 1 Year / Semester I

Prerequisites For Registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidate should pass in Under graduate Life Sciences.

Learning outcomes:

1. Learn

2. Topics to be covered in addition to

Objectives:

This course focuses on the principles, strategies, and applications of bioremediation and waste treatment technologies. Students will learn about various microbial processes and techniques used to remove or degrade pollutants from contaminated environments. The course also covers waste treatment methods and their environmental implications, with an emphasis on sustainable and eco-friendly approaches.

Detailed Syllabus

Theory

Unit 1: Introduction to Bioremediation and Waste Treatment: **9 Lecture**

Definition and scope of bioremediation and waste treatment, Overview of environmental pollution and waste generation, Significance of bioremediation and waste treatment technologies. Microbial Degradation of Pollutants: Introduction to microbial degradation processes, Microbial metabolism of different classes of pollutants (hydrocarbons, pesticides, etc.), Key microbial groups involved in biodegradation, Factors influencing microbial degradation efficiency.

Unit 2: Bioremediation Strategies and Techniques: 9 Lecture

In situ and ex situ bioremediation approaches, Bioaugmentation and bio stimulation techniques, Rhizoremediation and phytoremediation methods, Microbial consortia and their role in bioremediation. Biodegradation Pathways and Enzymes: Overview of biodegradation pathways for different pollutants, enzymes involved in pollutant degradation, Genetic and metabolic engineering for enhanced biodegradation, Applications of enzyme-based bioremediation.

Unit 3: Bioremediation of Soil Contamination: 9 Lecture

Strategies for remediating contaminated soil, microbial communities and their role in biodegradation, amendments and bioavailability enhancement techniques. Bioremediation of Water and Wastewater: techniques for water and wastewater treatment, Microbial processes for organic and inorganic pollutant removal, Biofilm-based treatment systems, Industrial wastewater treatment using bioremediation.

Unit 4 Bioremediation of Air Pollution: 9 Lecture

Microbial strategies for air pollution control, Biofiltration and bio trickling filters, Microorganisms involved in air pollutant degradation**,** Case studies of bioremediation of volatile organic compounds (VOCs). Bioremediation and Waste Treatment Regulations: Environmental regulations and guidelines for bioremediation, Risk assessment and management in bioremediation projects, Health and safety considerations in bioremediation processes, Monitoring and evaluation of bioremediation effectiveness.

Unit 5: **Bioremediation and Waste Treatment for Specific Pollutants: 9 Lecture**

Bioremediation of heavy metal-contaminated sites, Microbial treatment of oil spills, Remediation of pesticide-contaminated environments, Treatment of emerging pollutants (pharmaceuticals, microplastics). Sustainable Waste Treatment Technologies: Anaerobic digestion and biogas production from organic waste, Composting and vermicomposting techniques, Microbial fuel cells for waste treatment and energy generation, Circular economy approaches in waste management. Bioremediation Case Studies. Emerging Trends in Bioremediation and Waste Treatment: Advances in microbial genomics and metagenomics for bioremediation, Nanotechnology applications in pollution control, Integration of bioremediation with other treatment technologies, Innovative approaches for addressing complex waste streams.

Reference:

1. Bioremediation: Current Research and Applications by Ashok Rathour in 2017.
2. Bioremediation: Principles and Applications (Biotechnology Research Book 6) by Ronald L. Crawford and Don L. Crawford 1996.
3. Bioremediation: A Sustainable Approach to Preserving Earth's Water by Sanjay Sharma in 2019.

Downstream Processing

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences & Tech. **Degree:** M. Sc. Industrial Microbiology (PG)

Course Code: MIMML111 **Course Title:** Downstream Processing

Credits allocated: 3+0(3Theory+0 Practical) **Level of Study:** PG

Mode of Delivery, Planned Learning Activities &Teaching Method: Lecture 3 hrs / weekly

Recommended Year /Semester: Industrial Microbiology, M. Sc. 1 Year / Semester I

Prerequisites For Registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form. Candidate should pass in Under graduate Life Sciences.

Learning outcomes:

This course provides a comprehensive understanding of the principles and techniques involved in downstream processing in biotechnology. Students will learn about the purification and separation of biomolecules, including proteins, nucleic acids, and other cellular components, from a variety of biological sources. The course covers various unit operations, purification strategies, and analytical methods used in downstream processing.

Objective:

Maximize product recovery and, at the same time, minimize the cost of production. As for the recovery of biomass and PUFAs from microalgae, the recovery process may well exceed 60% of the production costs.

Detailed Syllabus

Theory

1. Unit Importance of Downstream Processing 9 Lecture

Definition and importance of downstream processing in biotechnology.Overview of the downstream processing work flow, Role of downstream processing in product purification and recovery

Principles of separation techniques (filtration, centrifugation, sedimentation)

Chromatographic separations and different modes (ion exchange, affinity, size exclusion)

Liquid-liquid extraction and its applications in downstream processing

Overview of other separation methods (membrane filtration, crystallization)

2. Unit Harvesting techniques for different bioprocesses: 9 Lecture

Harvesting techniques for different bioprocesses (microbial, animal cell culture, fermentation)
Cell disruption methods (mechanical, chemical, enzymatic) Clarification and separation of biomass from the culture medium, Primary recovery of intracellular products (cell debris removal, cell disruption, and extraction), Principles and applications of filtration, Microfiltration and ultrafiltration in bioprocessing, Membrane selection and optimization, Scale-up considerations for filtration operations.

3. Unit Sedimentation: 9 Lecture

Principles and applications of centrifugation, Sedimentation velocity and clarification centrifugation Density gradient centrifugation for separation of particles, Scale-up considerations for centrifugation processes, Principles and types of chromatography (ion exchange, affinity, size exclusion, hydrophobic interaction), Column chromatography techniques (packed bed, expanded bed, simulated moving bed), Optimization and scale-up of chromatographic processes, Protein refolding and renaturation using chromatography.

4. Unit Different type of strategies to recovery Protein: 9 Lecture

Recovery strategies for proteins, nucleic acids, and other biomolecules, Precipitation techniques (salting out, solvent precipitation), Extraction methods (liquid-liquid extraction, solid-phase extraction), Crystallization and precipitation of biomolecules, Strategies for purification of target biomolecules, Selective purification of high-value products (antibodies, enzymes, recombinant proteins), Multimodal and mixed-mode chromatography, Purification of viral vectors and gene therapy products.

5. **Unit Protein quantification methods: 9 Lecture**

Protein quantification methods (spectrophotometry, Bradford assay, ELISA), Purity analysis techniques (SDS-PAGE, capillary electrophoresis), Characterization of biomolecular interactions (surface plasmon resonance, isothermal titration calorimetry), Viral clearance strategies in downstream processing, Virus filtration and inactivation methods, Safety considerations in biopharmaceutical production, Quality assurance and regulatory aspects of downstream processing

Process validation and qualification, Design of experiments (DOE) and statistical analysis in process optimization, Process analytical technology (PAT) in downstream processing, Continuous downstream processing and integrated process development.

Reference:

1. Principles of Downstream Techniques in Biological and Chemical Processes by Mukesh doble in 2015.
2. "Bio separations – Downstream Processing for Biotechnology" by P A Belter and Wei-Houhu.
3. Sustainable Downstream Processing of Microalgae for Industrial Application by Kalyan Gayen, Tridib Kumar Bhowmick, et al. | 23 September 2019.
4. Downstream Processing (Advances in Biochemical Engineering/Biotechnology) by D. J. Bell, P. Dunnill, et al.1 January 1983

STRAIN DESIGN AND STRAIN IMPROVEMENT

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences & Tech. **Degree:** M. Sc. Industrial Microbiology (PG)

Course Code: MIMML112 **Course Title:** Strain Design and Strain Improvement

Credits allocated: 3+0(3Theory+0 Practical) **Level of Study:** PG

Mode of Delivery, Planned Learning Activities &Teaching Method: Lecture 3 hrs / weekly

Recommended Year /Semester: Industrial Microbiology, M. Sc. 1 Year / Semester I

Prerequisites For Registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidate should pass in Under graduate Life Sciences.

Learning outcomes:

Learn the Strain design and strain improvement

Topics to be covered in addition to Safety and Ethical Considerations, Case Studies and Applications.

Objectives:

This course aims to provide an in-depth understanding of the principles and techniques involved in designing and developing bacterial strains for industrial applications. Students will learn about various genetic engineering tools, genetic manipulation strategies, and optimization techniques used in strain development. The course will also cover ethical considerations and safety regulations associated with genetic engineering.

Detailed Syllabus

Theory

Unit 1. Introduction to Bacterial Strain Designing **9 Lecture**

Introduction to Bacterial Strain Designing: Overview of strain development in industrial microbiology, Importance and applications of bacterial strain design

Genetic Engineering Tools and Techniques: Recombinant DNA technology, Gene cloning methods (PCR, restriction enzymes, ligations), Plasmid and vector systems, Transformation techniques (electroporation, chemical transformation), Gene editing tools (CRISPR-Cas9, TALENs, ZFNs)

Unit 2. Gene Expression Systems: **9 Lecture**

Gene Expression Systems: Promoters and regulatory elements, Inducible and constitutive expression systems, Optimization of gene expression

Metabolic Engineering and Pathway Design: Introduction to metabolic engineering, Targeted metabolic pathways for strain improvement, Flux analysis and pathway optimization

Unit 3. Strain Improvement Strategies: **9 Lecture**

Strain Improvement Strategies: Random mutagenesis and screening techniques, Directed evolution approaches, Rational engineering for strain improvement, Synthetic biology approaches.

Genetic Modification for Enhanced Productivity: Overexpression of target genes, Knockdown and knockout strategies, Gene silencing techniques, Enhanced production of secondary metabolites

Unit 4: Optimization of Cultivation Conditions: **9 Lecture**

Optimization of Cultivation Conditions: Medium formulation and optimization, Fermentation strategies, Process parameters affecting strain performance, Scale-up considerations.

Unit 5: Safety and Ethical Considerations: **9 Lecture**

Safety and Ethical Considerations: Biosafety regulations and guidelines, Risk assessment and mitigation strategies, Ethical considerations in genetic engineering, Intellectual property rights and patenting. Case Studies and Applications: Industrial applications of genetically engineered strains, Case studies highlighting successful strain design, Emerging trends in strain development

Suggested Reading/ Reference Books/ Text Books

1. Principles of Gene Manipulation and Genomics (link is external) – 7th Edition – Sandy B.Primrose, Richard Twyman – Blackwell Publishing

2. Gene Cloning and DNA Analysis: An Introduction (link is external) - 6th Edition - T. A.Brown - John Wiley & Sons

3. An Introduction to Genetic Engineering (link is external) - 3rd Edition - Desmond S.T.Nicholl - Cambridge University Press

4. Molecular Biotechnology: Principles and Applications of Recombinant DNA (link is external)- 4th Edition - Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten - ASM Press.

5. Synthetic Biology: Tools and Application by Huimin Zhao

6. Bioengineering: A conceptual Approache by Mirjana Pavlovic

7. Synthetic biology : a lab manual by *Liljeruhm, Josefine; Gullberg, Erik; Forster, AnthonyC.*

8. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC (2006).

9. Eric Davidson, The Regulatory Genome: Gene Regulatory Networks In Development And Evolution, Academic Press (2006).

10. Hamid Bolouri, Computational Modeling Of Gene Regulatory Networks - A Primer, Imperial College Press (1st edition) (2008).

11. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter, Molecular Biology of the Cell, Garland Science (4th edition) (2002).

12. Robert Brooks Phillips, Jane Kondev and Julie Theriot, Physical Biology of the Cell, Garl and Science (1st edition) (2008).

13. Mark Ptashne and Alexander Gann, Genes and Signals, Cold Spring Harbor Laboratory Press (1st edition) (2001)

GENOMICS & BIOINFORMATICS

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. IM (PG)

Course Unit Code: MIMML113 **Course Title:** Genomics & Bioinformatics

Credits allocated 3+0 (3Theory+0 Practical) **Level of Study:** PG

Mode of Delivery, Planned Learning Activities and Teaching Method: Lecture 3 hrs weekly

Recommended Year /Semester: 1 Year / Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and adviser and acceptance by the principal. The approved courses must be mentioned in the roster form. Candidate should pass in post graduate life science.

Learning outcome

On completion of the course, the student should be able to:

1. Access and browse a range of structural data repositories
2. Explain the relationship between protein sequence and protein structure
3. Describe how structure translates into function within different biological fields such as catalysis, transport and regulation
4. Estimate the validity of information in macromolecular structure databases, and use computer programs to visualise and analyse macromolecular structures from a functional perspective
5. Use bioinformatics tools for sequence alignment, sequence motif identification and prediction of secondary and tertiary structure.

Objectives:

Structural biology, determining the three-dimensional shape of a protein, can tell us a lot about how a protein functions and the role it plays within a cell. Bioinformatics data derived from structural determination experiments can aid biological researchers asking a wide variety of

questions. It aides the understanding of how DNA mutations might alter a protein's shape, disrupt a catalytic site, or alter the binding affinity of a pharmaceutical compound.

This course explores bioinformatics data resources and tools for the interpretation and exploitation of bio-macromolecular structures. It will focus on how best to analyse available structural data to gain useful information given specific research contexts. The course content will investigate the impact of genetic variation on structure, predicting protein structure and function, and exploring interactions with other macromolecules as well as with low-MW compounds. Participants will also have an opportunity to explore protein docking using HADDOCK.

This course will enable the students to:

The students shall obtain necessary skills to analyse and predict structural properties of biological macromolecules and complexes, which includes proteins and nucleic acids. Our students shall gain a good understanding of key concepts of structure and dynamics of biological assemblies at the atomic, molecular, and cellular level.

- understand the levels of structural organization of macromolecules and experimental methods of structure determination
- know the approaches for structure analysis
- acquire knowledge of various algorithms & methods of structure prediction
- Understand the principles of macromolecular interactions.

Detailed Syllabus

Theory

UNIT I Relation between sequence and function: 9 Lecture

Relation between sequence, structure and function. Structural basis for macromolecular dynamics, bindinspecificity and catalysis. Overview of biologicaldatabases, servers and information centres. Sequence comparisons. Basic macromolecular structure: three-dimensional structure, PDB co-ordinates, classification of proteins in structure families, programs for analysis and comparison of structures. Introduction to the theory of

classification and comparison of sequences and extraction of common distinctive features (e.g., motifs). Sequence analysis for prediction of secondary and tertiary structures, and homology modelling of three-dimensional structures based on sequence data.

UNIT II Macromolecular Structure Protein **9 Lecture**

Macromolecular Structure Protein - Primary, Secondary, Super secondary, Tertiary and Quaternary structure, Potential energy maps, Ramachandran map, Nucleic acid – DNA and RNA, Carbohydrates o Co-ordinate systems.

UNIT III. Different type of experimental techniques **9 Lecture**

Overview of experimental techniques to study macromolecular structures o Methods to study3D structure: X-ray, NMR, Cryo-electron microscopy o Validation using Procheck, ProsaII.

UNIT IV. Study of Protein folding **9 Lecture**

Principles of protein folding and methods to study protein folding · Macromolecular interactions, Protein – Protein, Protein – Nucleic acids Protein – carbohydrates.

UNIT V Structures of Proteins **9 Lecture**

Structure of Ribosome · Prediction of protein structure. secondary structure prediction methods. First, second and third generation methods. Tertiary structure prediction Homology modelling, fold recognition and ab initio methods.

- Public repositories of structural data: Protein Data Bank (PDB) and Electron Microscopy Data Bank (EMDB), and tools to search and analyse information in these repositories from PDBe (Protein Data Bank in Europe).
- Computational approaches to structure prediction: ModBase, Rosetta, PHYRE, Interactome 3D.
- Protein docking: HADDOCK.
- Impact of genetic variation on protein structure: Ensembl VEP, DBSeq, SAAPdb
- Protein analysis and classification: Pfam, CATH, SCOP, InterPro, PDBeFold, PDBePISA, Pro Function.
- Tools and resources for drug discovery: ChEMBL.

Suggested Reading/ Reference Books/ Text Books

1. The Molecules of Life – Physical and Chemical Principles. First Edition, 2012. John Kuriyan, Boyana Konforti, and David Wemmer. Garland Science. Taylor & Francis.
2. Forbes Burkowski. Structural bioinformatics: An algorithmic approach. Publisher: CRC Press, 2009. ISBN: 9781584886839.
3. Introduction to Proteins – Structure, Function, and Motion. First Edition, 2011. Amit Kessel and Nir Ben-Tal. Chapman &Hall/CRC. Francis & Taylor Group.
4. Structural Bioinformatics, Vol. 44, Series: Methods of Biochemical Analysis; 2005

5. Editor(s): Philip E. Bourne, Helge Weissig. Print ISBN: 9780471202004; Online ISBN: 9780471721208; DOI: 10.1002/0471721204

Text Book

1. Drenth Jan. Principles of Protein X-Ray Crystallography. Publisher: Netherlands, Springer Science. 2007. ISBN: 9780387333342.
2. Bourne Philip E., Weissig Helge. Structural Bioinformatics (Methods of Biochemical Analysis, V. 44), 2003. Publisher: Wiley-Liss. ISBN: 0471202002.
3. Höltje Hans-Dieter, Sippl Wolfgang, Rognan Didier, Folkers Gerd. Molecular Modeling: Basic Principles and Applications. Publisher: New York, Wiley-VCH. 2003. ISBN: 3527305890.
4. Leach, Andrew. Molecular Modelling: Principles and Applications. Publisher: Prentice Hall. 2001. ISBN: 0582239338. · Friesner Richard A. Computational Methods for Protein Folding:advances in Chemical Physics Volume 120 Kindle Edition. Publisher: New York, John Wiley & Sons. 2002. ISBN: 0471209554.
5. Heilmeyer L., Friedrich P. Protein Modules in Cellular Signalling. Publisher: Amsterdam, IOS Press. 2001. ISBN: 1586031805.
6. Rhodes Gale.Crystallography Made Crystal Clear, Third Edition: A Guide for Users of Macromolecular Models. Publisher: USA, Academic Press 2000 ISBN: 0125870728.
7. Branden ,Tooze John. Introduction to Protein Structure. Publisher: New York, Garland Publishing Inc. 1999. ISBN: 0815323050.
8. Hill H.A.O. Sadler P.J., A.J. Ed. Metal Sites in Proteins and Models Redox Centres

Publisher: New York, Springer 1999. ISBN: 3540655564.

9. Sternberg Michael J. E. Protein Structure Prediction: A Practical Approach. Publisher: USA, Oxford University Press. 1997. ISBN: 0199634953.
10. Fasman G.D.Prediction of Protein Structure and the Principles of Protein Conformation. Publisher: New York, Plenum Press. 1989 ISBN: 0306431319.
11. Creighton T. E. Editor. Protein Structure: A Practical Approach. Publisher: IRL Press at Oxford University Press. 1989. ISBN: 0199630011.

Microbial Lab

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Industrial Microbiology (PG)

Course Unit Code: MIMEP114 **Course Title:** Microbial Lab

Credits allocated: 0+2 (0 therory+2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester II

Learning Outcome: Perform biochemical tests used in the identification of bacteria. Evaluate the results of the biochemical tests. Judge which tests are appropriate for some bacteria, but not others. Formulate how you will organize and address identifying unknown bacteria based on observations of the patterns in your results.

Objective:

The objective of this laboratory is to discriminate among different types of cells, to handle the microbial culture individually and produce and analyze the product from microbes in relevant media.

Practical List:

1. To investigate the ability of microorganisms to degrade petroleum hydrocarbons.

2. Set up a composting system to study the decomposition of organic waste using microbes.

3. Bioremediation of oil spills: Stimulate an oil spill and test the efficiency of different microbial strains.

4. To investigate the ability of microorganisms to break down the plastics.

5. Study the decomposition of organic waste using earthworms and their role in nutrient recycling

6. production of methane gas by using microbes

7. Study of different types of filters (eg. depth filters, membrane filters) to remove particles, cells or debris from the mixture.

8. To separate the particles based on their size, density or shape by using centrifugation.

9. To separate the product on its specific properties such as charge size or affinity ligand by using chromatography.

10. Apply distillation techniques to separate and concentrate the product based on difference boiling point (ethanol)

11. To optimize the stability and compatibility of the product by using different buffer solution.

12. To perform final product (protein) characterization by using analytical tests (SDS-PAGE)

13. To perform paper chromatography for the identification of biomolecules.

14. To induce the mutation in microbial strain using physical or chemical methods to generate genetic diversity and identify the variants with improved traits.

15. Compare the productivity of different microbial strains by measuring the production of the desired compound.

16. Cultivate the microbes under selective conditions continuously to observe improve strains.

17. To assess the effect of different culture conditions (eg. temperature,pH, carbon source) on the growth and productivity of microbial strains.

18. Optimize the composition of growth media by varying nutrient concentrations and supplements to enhance strain performance.

19. Optimize the fermentation parameters (eg. aeration, agitation) to maximize product yield and improve strain improvement.

20. Subject the strains with improved stress condition (eg temperature, pH, osmolarity) to identify strains with improved stress tolerance.

Reference:

1. Authors: Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock.
2. Safeguards in the School Laboratory, 11th edition (ASE 2006) – General safety guidance. Health & Safety legislation, managing, safety GLP, use of pressure vessels, section on biological hazards in microbiology.

Biotechnique Lab

University: MGM University, Chh. Sambhajinagar **Faculty: Basic & Applied Science**

Institute: Institute of Biosciences and Tech. **Degree: Industrial Microbiology (PG)**

Course Unit Code: MIMEP115 **Course Title: Biotechnique Lab**

Credits allocated: 0+2 (0 therory+2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester II

Learning outcome: Practical skills and competencies are critical to student engagement and effective learning in laboratory courses. This article describes the design of a yearlong, stand-alone laboratory course—the Biotechniques Laboratory. A common core course in the second year of all our degree programs in the biological sciences. It is an enabling, introductory laboratory course with a focus on the development of basic, practical skills, competencies, and knowledge in experimental techniques commonly used across the biological sciences.

Objective:

Collect and prepare the sample Handle fully automated analyzers Understand and perform special stains and smears Understand and perform basic cytology and hematology procedures Perform grossing, cutting & staining procedures in histopathology Counsel and screen the Donors and prepare the blood components Perform Quality control procedures.

Practical List:

1. To study the aseptic techniques and microbial culture handling.
2. To prepare media for microbial growth
3. To study sterilization techniques (autoclaving, filtration)
4. To isolate and identify industrial microorganism (eg. *S. cerevisiae*)
5. To study microbial growth kinetics
6. To screen industrially important microbial strains for the production of enzymes (Amylase, cellulase, protease etc.)

7. Production of enzyme and its purification (amylase)

8. Production of microbial antibiotic (Penicillin)

9. Production of biofuels (ethanol)

10. To study bioprocess monitoring and control

11. To study the optimization of culture condition (pH, Temperature)

12. Production of cellulase enzyme.

13. Fermentation of organic acid (citric acid, lactic acid)

14. Production of vitamins by using microbes

15. To study the downstream processes (filtration, purification)

16. To study the bioprocess monitoring and control. (pH, temperature, dissolve oxygen) using sensors.

17. immobilization of microbial cells or enzymes.

18. Production of microbial biofertilizers for improving soil fertility.

19. Determination of microbial growth kinetics by using various media and growth condition.

20. Screening for antimicrobial activity of microbial isolates against pathogenic bacteria or fungi.

Reference:

1. Basic laboratory methods for biotechnology lab by Lisa A. Seidman, Cynthia J. Moore, 2009.
2. Basic laboratory methods for biotechnology and science by Benjamin-Cummings Publishing Company, 27-Oct-2010.

GENOMICS EXPLORATION LABORATORY

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Industrial Microbiology (PG)

Course Unit Code: MIMEP116 **Course Title:** Genomics Exploration Laboratory

Credits allocated: 0+2 (0 therory+2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester II

Learning Outcomes:

With the increased advances in genomics, leading health authorities have advocated the importance of incorporating genomics content into health professional school education to ensure those students achieve adequate genomic competencies. Yet, information regarding the genomics education status for this particular group is lacking. We conducted a systematic literature review to summarize the characteristics and evaluation outcomes of genomics curricula for health professional students.

Objective:

Discoveries of the genomes of literally thousands of organisms inhabiting this planet have facilitated renewed emphasis on the study of life and its meaning in the social sciences and humanities as well as in the life sciences. For every individual, experiencing and living the implications of such scientific discoveries depends on understanding the social and personal complexity embedded within the many contexts and filters applied to genomic information – in research labs, computer science and data management, quantitative biology, ethics debates dealing with emerging technological capabilities, genome databases, social interactions, and policy deliberations.

Practical List:

1. Isolation of antibiotic resistant bacterial population by gradient plate method.
2. Isolation of Streptomycin resistant mutant by replica plating method.
3. Demonstration of genetic recombination in bacteria by conjugation
4. Isolation of plasmid from bacteria.
5. To prepare competent cell & transformation plasmid DNA.
6. Transformation of different plasmid from different bacteria
7. UV induced extropicmutant production & isolation of mutant by replica plating.
8. Spontaneous mutation, induced mutation by chemical mutagenesis.

9. UV survival curve of bacteria.
10. Photoreactivation.
11. To study the spontaneous mutation by replica plating.
12. To study the process of Gene expression in bacteria.
13. To learn the process of cloning of foreign gene into vector.
14. To study yeast competent cell & transformation yeast plasmid DNA.
15. To understand the principle of pH meter, colorimeter, spectrophotometer, UV spectra,
16. To study and understand the different types of centrifuge.
17. To study & understand different types of microscope with the help of different types of samples.
18. To isolate the genomic DNA from *E.coli*
19. Isolation of plant genomic DNA.
20. To study research paper.

Reference:

1. Plainview, N.Y,: Cold Spring Harbor Laboratory Press,1997.
2. Genetics Laboratory Investigations by Mertens, Thomas L; Hammersmith, Robert L.,2006.

Bioinformatics Lab

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Industrial Microbiology (PG)

Course Unit Code: MIMEP117 **Course Title**: Bioinformatics Lab

Credits allocated: 0+2 (0 therory+2 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs weekly

Recommended Year /Semester: Industrial Microbiology, Year I/ Semester II

Learning Outcomes:

(a) Advanced methods in computational biology,

(b)Introduction to metagenomics as well as microbial sequencing

(c) The design and implementation of relational databases,

(d) To detect the sequence quality checking

Objective:

To provide students with a practical and hands-on experience with common bioinformatics tools and databases. Students will be trained in the basic theory and application of programs used for database searching, Molecular modeling as well as microbial phylogenetic trees.

Practical List:

1. Bioinformatics in microbiology and industrial biology
2. Introduction to metagenomics
3. Introduction to metatranscriptomics
4. Introduction to metabolomics
5. Microbial sequence retrieval
6. Microbial databases
7. Sequence alignment
8. Microbial phylogeny
9. Sequence quality checking
10. Motif identification
11. Domain and family identification
12. Family identification
13. Understanding microbial gene mapping
14. Understanding microbial gene expression
15. Understanding microbial taxonomic information
16. Diversity analysis

17. Sequence quality checking
18. Diversity analysis
19. Molecular modelling
20. Computer aided drug design
21. Industrial application of microbial- bioinformatics
22. Functional classification of microbe

Micro Project

University: MGM University, Chh. Sambhajinagar **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Industrial Microbiology (PG)

Course Unit Code: MIMMJ118 **Course Title:** Micro Project

Credits allocated: 0+2**(**0 theory+2practical) **Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 4 hrs weekly.

Recommended Year /Semester: M.Sc. Industrial Microbiology, Year 1/Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Learning Outcomes:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Objective:

Industrial microbiology is a branch of biotechnology that applies microbial sciences to create industrial products in mass quantities, often using microbial cell factories. There are multiple ways to manipulate a microorganism in order to increase maximum product yields. Introduction of mutations into an organism may be accomplished by introducing them to mutagens.

Thrust Area of Project:

- Regenerative medicine
- Stem cell engineering
- Pathogen & amp; infection
- Development of multicellular organisms
- Energy conversion: Mitochondria & chloroplast
- Biomaterial science

- Tissue engineering
- Micro evaluation
- Microbiome
- Host-microbe interaction
- Bioelectronics
- Sustainable biotechnology
- Microbial biosynthesis
- Bioprocess Optimization and modelling
- Industrial microbiology and sustainability/ Sustainability and circular economy
- Novel enzymes and bio catalysis
- Microbiome engineering for bioprocessing
- Biofilm engineering and application
- Process analytics and big data
- Bioprocess intensification and miniaturization.

RNA biology

- RNA vaccine
- Climate change as biotechnology

FIELD PROJECT

University: MGM University, Chh. Sambhajinagar	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree: M.Sc.** IM (PG)
Course Unit Code: MIFPJ119	**Course Title:** Field Project
Credits allocated: 0+4 (Practical)	**Level of Study: PG**

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs / weekly

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Learning outcome:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.

2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Objective:

The field of industrial microbiology and biotechnology has had a lot of beneficial contributions in the areas of healthcare, agriculture, food production, the manufacture of industrial enzymes.

Thrust Area of Project:

- Regenerative medicine
- Stem cell engineering
- Pathogen & amp; infection
- Development of multicellular organisms

- Energy conversion: Mitochondria & chloroplast
- Biomaterial science
- Tissue engineering
- Micro evaluation
- Microbiome
- Host-microbe interaction
- Bioelectronics
- Sustainable biotechnology
- Microbial biosynthesis
- Bioprocess Optimization and modelling
- Industrial microbiology and sustainability/ Sustainability and circular economy
- Novel enzymes and bio catalysis
- Microbiome engineering for bioprocessing
- Biofilm engineering and application
- Process analytics and big data
- Bioprocess intensification and miniaturization.

RNA biology

- RNA vaccine
- Climate change as biotechnology