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

Biotechnology - CURRICULUM

w. e. f. Academic Year 2023-24

M.Sc. Biotechnology

CURRICULUM

Prepared By
Dr. V. U. Dange

Submitted By
Dr. G. W. Narkhede

Approved By
Board of Studies

Illustrative Credit distribution structure for Two Years/ One Year PG									
M.Sc. Post Graduation Programme (M.Sc. Biotechnology)									
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 (4*3 +2)	4	**-**	4	**-**	22	
Cum. Cr. For PG Diploma			**27**	**8**	**4**	**4**	**-**	**43**	
Exit option: PG Diploma (43 Credits) after Three Year UG Degree									
II	**6.5**	**III**	12 (3*4)	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. Biotechnology																			
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	**MBMML101**	**Molecular Cell Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML102	**Biostatistics and data analysis**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML103	**Biochemistry and Enzymology**	**Theory**	**Major Mandatory**	2	-	2	10	10	10	-	20	-	50	-	8	-	20
	MBMML104	**Microbiology and Immunotechnologies**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MPMEP105 **MPMEP106**	**1. Bioindustry Lab (Practical)** **2. Fermentation Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	0	20	50	-	-	8	20
	MPMEP107 **MPMEP108**	**1. Bioskill Lab (Practical)** **2. Biochemistry Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30		20	50	-	-	8	20
	MBMMJI109	**Mini Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30		20	50	-	-	8	20
		Research Methodology	**Theory**	**RM**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
		Total (L- P) Hrs / week = 27			**15**	**12**	**21**	**90**	**90**	**90**	**90**	**180**	**60**	**600**		**72**	**24**	**240**

Semester II (M.Sc. BT)																			
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	**MBMML110**	**Cell Culture Technology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML111	**Editing life: genetic engineering and synthetic biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML112	**Industrial Biotechnology: Enzymes, Biochemicals and Biomaterials**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML113	**Bioinformatics and computational Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMEP114 MBMEP115	**1. Exploration Biotechnology (Practical) 2. Cell Culture Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MBMEP116 MBMEP117	**1. Biofactory Laboratory (Practical) 2. Bioinformatics Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MBMMJ118	**Micro Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MBFPJ119	**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. BT)																			
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	**MBMML201**	**Protein Engineering for Industrial Biotechnology**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MBMML202	**Cell Culture Engineering: Recombinant Protein Production**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MBMML203	**Genomics, Proteomics and Metabolomics**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MBMEP204 MBMEP205	**1. Bioinovation Lab (Practical) 2. Biopharmaceutical lab**	**Practical**	**Major Elective**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
	MBRPJ206	**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. BT)																	
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	**MBMEL207 MBMEL208**	**1. Ethics/ Biosafety/ IPR 2. Scientific writing and Presentation**	**Theory**	**Major Elective**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MBJTI209	**On Job Training**	**OJT**	**Major Mandatory**	-	20	10	-	-	-	200	-	50	250	-	-	20	50
	MBRPJ210	**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 credit

MOLECULAR CELL BIOLOGY

University: MGM University, Aurangabad **Faculty:**Basics&Applied Sciences

Institute: Institute of Biosciences and Technology **Degree:**M.Sc.Biotechnology (PG)

Course Unit Code: MBMML101 **Course Unit Title:** Molecular cell biology

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

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

Recommended Year /Semester: Biotechnology-Master's of Science, Year I/ I Semester

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

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.

BIOCHEMISTRY AND ENZYMOLOGY

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Technology (PG) **Degree:** M.Sc.Biotechnology

Course Unit Code: MBMML103 **Course Unit Title:** Biochemistry and Enzymology

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

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

Recommended Year /Semester: Biotechnology Masters of Science, Year I/ 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 post graduate life science.

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

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.

Detailed Syllabus

Theory

Unit I: Introduction to Biochemistry 7Hrs

Overview of biochemistry and its significance in biotechnology
Structure and function of biomolecules (proteins, carbohydrates, lipids, nucleic acids)
Biochemical techniques and laboratory safety

Unit II: Protein Structure and Function
8Hrs

Amino acids and peptide bonds
Protein structure levels (primary, secondary, tertiary, quaternary)
Protein folding and stability
Enzymes and enzyme kinetics

Unit III: Carbohydrate and Lipid Metabolism
8Hrs

Carbohydrate metabolism (glycolysis, gluconeogenesis, glycogen metabolism)
Lipid metabolism (fatty acid oxidation, lipogenesis, cholesterol metabolism)
Metabolic regulation and metabolic diseases

Unit IV: Enzymology and Enzyme Regulation
7Hrs

Enzyme classification and nomenclature
Enzyme kinetics and mechanisms
Enzyme regulation and inhibition
Enzymes in biotechnology applications

Suggested Reading/ Reference Books/ Text Books

1. Berg, J. M., Stryer, L (2002) *Biochemistry* W.H Freeman &Company
2. General Enzymology, Himalaya Publications
3. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Bonner Philip and Trevor Palmer
4. Nelson,D. L.,Cox,M(2008) *Lehninger's Principles of Biochemistry* Mac Millan
5. Voet,D and Voet, J.G (2010) *Biochemistry* 4th edition Wiley
6. Jain,J.L(2005)*Fundamentals of Biochemistry* 6 th edition S.Chand & Co
7. Deb,A.C(2001*) Fundamentals of Biochemistry* New Central Book Agency(P) Ltd
8. Pelczar,M.J., Chan,E.C.S and Kraig(1977) *Microbiology* Mc Graw-Hill
9. Talaro, K.P., and Talaro A (2004) *Foundations of Microbiology* 5 th edition Mc Graw-Hill
10. Aneja, K.R., Jain, P. and Aneja, R (2008) *Text book of Basic and Applied Microbiology* New Age International
11. Harper's Illustrated Biochemistry 28th edition
12. Fundamentals of Biochemistry 2nd edition by Donald Voet, Judith G. Voet, Charlotte W. Pratt
13. Principles of Biochemistry 5th edition by Michael M. Cox & David L. Nelson
14. Biochemistry by U. Satyanarayana & U. Chakrapani

MICROBIOLOGY AND IMMUNOTECHNOLOGIES

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science

Institute : Institute of Biosciences and Technology **Degree:**M.Sc.Biotechnology (PG)

Course Unit Code:MBMML104 **Course Unit Title:** Microbiology &Immunotechnologies

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

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

Recommended Year /Semester: Biotechnology -Masters of Science, Year I/ I Semester

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:

During the course, the student should achieve knowledge about microorganisms and their metabolism and physiology, and get training in problem-solving, critical and ethical analysis of scientific work in the field. On completion of the course, the student should be able to:

1. account for morphology, metabolism, physiology and evolution of microorganisms; explain some vital processes at the molecular level and relate this to adaptation processes of microorganisms
2. account for different methods of cultivation of microorganisms and how these can be used in industrial context
3. explain co-operation between microorganisms via different signalling processes, how these function on the molecular level and control complex processes such as differentiation and biofilm formation
4. work with microorganisms at the laboratory and characterise both physiological and molecular properties
5. analyse microbiological research data, draw conclusions from them and design testing hypotheses from the analysed data
6. analyse critically and ethically scientific work within the field

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

1. Students will be able to differentiate between the different domains of life
2. Students will be able to learn about various life forms based on their nutritional and energy source requirements based on the concept of energetics.
3. Students will learn the different modes of growth of microorganisms and can apply their knowledge on industrial production of various microbial products.

4. Students will learn about the role of microorganisms in ecology and environment and will use their knowledge for various environmental solutions; bioremediation; biofuel etc.
5. Students will be able to understand the working and activity of immune system
6. Students will gain the knowledge of techniques in immunology

Detailed Syllabus

Theory

Unit 1 Introduction

9Hrs

The structure and function of cells, Molecular mechanisms behind cell function, Microbial diversity and evolution, microbial genetic exchange, molecular phylogeny, Groups of bacteria, Archaea and unicellular eukaryotes.

Unit 2 Metabolism, physiology and Earth's Microbiomes

9Hrs

Metabolism and physiology: Aerobic and anaerobic energy production, uptake and secretion mechanisms.Cell growth, cell culture and cultivation methods. Co-operation between organisms: signalling, attack and defence; biofilm, differentiation. Virulence factors, secondary metabolism, production of antibiotics and resistance.

Earth's Microbiomes- general introduction to the diverse roles of microorganisms in natural and artificial environments. Energetics, and growth; evolution and gene flow; population and community dynamics; water and soil microbiology; biogeochemical cycling; and microorganisms in bio-deterioration and bioremediation.

Unit 3 Methods in immunology

9Hrs.

Serology- Introduction and classification of antigens and antibody reactions – Agglutination and precipitation reactions. Strength of antigen and antibody binding- Affinity & Avidity. Monoclonal antibodies and their applications. Immunofluorescence RIA, ELISA, Flowcytometry, Microscopy.

Unit 4 Genomics and Evolution of Infectious Disease

9Hrs.

Genomics and Evolution of Infectious Disease--introduction to the forces driving infectious disease evolution, relevant to public health. Mechanisms of genome variation in bacteria and viruses, population genetics, outbreak detection and tracking, strategies to impede the evolution of drug resistance, emergence of new disease, microbiomes and metagenomics.

Unit 5 Cellular and Molecular Immunology

9Hrs.

Cells of the Immune System, Lymphocyte Homing, Antibodies and Antigens, Antigen Receptors and the Generation of Diversity, B Lymphocyte Development and Activation, Antibody Dependent Protection , T Lymphocyte Development, Signal Transduction in Lymphocytes I , Cell Mediated Immunity, Signal Transduction in Lymphocytes II , Dendritic Cells, Frontiers: Co-stimulation, Memory and Death, Immunology of TB, Immune Mediated Injury, Asthma and Allergy, Frontiers: DC and Innate Immunity, Multiple Sclerosis, Frontiers: Autoimmune TCRs, Leukaemia and Lymphomas, CD1 and Lipid Antigens , Transplantation Immunology, Immunology of HIV/AIDS, Frontiers: Genetic Instability and Cancer , Regulatory T Cells , Bone Marrow Transplant, Tumour Immunology, Regulating Humoral Autoimmunity , Inflammatory Bowel Disease , Immunodeficiency Disorders , RA and Lupus, Genetic Susceptibility to Disease

Suggested Reading/ Reference Books/ Text Books

1. Lansing M Prescott -Microbiology 5th Edition
2. Kuby - Immunology 6th Edition
3. Abbas, Abul K., and Andrew Lichtman. *Cellular and Molecular Immunology*. 6th ed. Philadelphia, PA: Saunders, 2005. ISBN: 9781416023890.
4. Rosen, Fred, and RaifGeha. *Case Studies in Immunology: A Clinical Companion*. 4th ed. New York, NY: Garland Pub., 2004. ISBN: 9780815341024. (Paperback)
5. Janeway, Charles A., et al. *Immunobiology: The Immune System in Health and Disease*. New York, NY: Garland Science, 2004. ISBN: 9780443073106 .
6. Santiago, F. Elena, and Richard E. Lenski. "Evolution Experiments with Microorganisms: The Dynamics and Genetic Bases of Adaptation." *Nature Reviews Genetics* 4 (2003): 457-469.
7. Tamas, Ivica, et al. "50 Million Years of Genomic Stasis in Endosymbiotic Bacteria." *Science* 296 (2002): 2376-2379.
8. Wu, Dongying, et al. "Metabolic Complementarity and Genomics of the Dual Bacterial Symbiosis of Sharpshooters." *PLOS Biology* 4 (2006): 1079-1092.
9. Freeman, Scott. *Biological Science*. Upper Saddle River, NJ: Prentice Hall, 2002. ISBN: 9780130819239.

BIOINDUSTRY LAB

University: MGM University, Aurangabad **Faculty:** Basics & Applied Sciences

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

Course Unit Code: MBMEP105 **Course Unit Title:** Bioindustry Lab

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

Mode of delivery, planned learning activities and teaching method: Practical 6 hrs / weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ Semester I

Practical List:

1. Bioreactor design
2. Study of bacterial batch growth curve
3. Study of bacterial batch growth kinetics
4. Effect of substrate concentration on Enzyme kinetics
5. Effect of temperature on Enzyme kinetics
6. Production of Ethanol
7. Production of SCP
8. Amylase production by Aspergillus niger
9. Penicillin Fermentation
10. Bioassay of Penicillin

Suggested Reading/ Reference Books/ Text Books

1. Standard methods of biochemical analysis S.R. THIMMAIAH
2. Practical Microbiology book by D. K. Maheshwari.
3. Experiments in Microbiology, Plant Pathology and Biotechnology K.R. Aneja

FERMENTATION LAB

University: MGM University, Aurangabad **Faculty:** Basics & Applied Sciences

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

Course Unit Code: MBMEP106 **Course Unit Title:** Bioindustry Lab

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

Mode of delivery, planned learning activities and teaching method: Practical 6 hrs / weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ Semester I

Practical List:

1. Fermentation of wheat bran/ cellulose/ birchwood xylan by Trichoderma
2. Analysis of spent broth
3. Purification and precipitation secreted proteins from spent broth
4. 2-D gel electrophoresis of precipitated protein
5. Estimation of cellulase activity of cellulose degraders
6. Estimation of cellulose/xylanase activity in broth and precipitated protein fraction
7. Production of algal biomass.
8. Microbial production of Vitmain B12 and assay
9. Fermentation of lignocellulolytic biomass
10. Detection of GMO food
11. Microbial load of canned foods
12. Analysis of preserved food stuff for presence of pathogens
13. Detection of viable, non-viable and viable but nonculturable cells by fluorescence microscopy in GMO products
14. Visit to Bioprocessing plant

Suggested Reading/ Reference Books/ Text Books

1. Gautam, N. C., Food Biotechnology in Comprehensive Biotechnology, Vol. 6., Shree Publishers, New Delhi, 2007
2. Gutierrez –Lopez, G. F. et. al., Food Science and Food Biotechnology. CRC Publishers, Washington, 2003
3. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK .

International, New Delhi, 2006

4. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995.
5. Waites, M. J. et. al., Industrial Biotechnology: An Introduction, Blackwell publishing, UK, 2007.
6. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers.
7. Glaser A.N and Nilaido.H (1995) Microbial Biotechnology, W.H Freeman and Co.
8. Prescott and Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
9. Prescott and Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.

BIOSKILL LAB

University: MGM University, Aurangabad **Faculty:** Basics & Applied Sciences

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

Course Unit Code: MBMEP107 **Course Unit Title:** Bioskill Lab

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

Mode of delivery, planned learning activities and teaching method: Practical 6hrs weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ Semester I

Practical List:

1. To understand the principle of pH meter, colorimeter, spectrophotometer.
2. To study basic law of light absorption and standard curve.
3. To study the method & calculation of cell count by Neubauer chamber
4. Double immune diffusion assay
5. Blood agglutination test
6. Widal test
7. ELISA
8. Estimation of protein by Lowry method
9. Estimation of protein by biuret method
10. Quantitative method of reducing sugar by DNSA method
11. Qualitative analysis of carbohydrates by Molisch reagent
12. Qualitative analysis of carbohydrate by benedict's method
13. Qualitative analysis of carbohydrate by Fehling's test

Suggested Reading/ Reference Books/ Text Books

1. Laboratory Manual for Biotechnology by Ashish S. Verma, Surjit Das and Anchal Singh

BIOCHEMISTRY LAB

University: MGM University, Aurangabad **Faculty:** Basics & Applied Sciences

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

Course Unit Code: MBMEP107 **Course Unit Title:** Biochemistry Lab

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

Mode of delivery, planned learning activities and teaching method: Practical 6hrs weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ Semester I

Practical List:

1. Estimation of RNA by orcinol method
2. TLC-Separation of lipids by TLC method
3. Separation of amino acids by paper chromatography.
4. Titration-Estimation of pKa values of amino acid by titration curves.
5. Isolation of DNA
6. Preparation of competent cells
7. Gel electrophoresis
8. PCR
9. Bioassay of Vitamins
10. Estimation of RNA by orcinol method
11. Separation of lipid by TLC method
12. Separation of amino acids by paper chromatography
13. Estimation of pKa values of amino acid by titration curves.
14. To study & Understand different types of Centrifuge
15. To study & Understand different types of Microscope with the help of different types of samples

MINI PROJECT

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Technology **Degree:** M.Sc. Biotechnology (PG)

Course Unit Code: MBMMJ109 **Course Unit Title:** Mini Project

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

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

Recommended Year /Semester: Biotechnology 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.

Candidates should pass in undergraduate Life Science.

Course 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.

Research Thrust Areas:

Plant tissue culture, Molecular biology, Data interpretation, Mycology, Microbiology, Quantitative and qualitative experimental research, Synthetic biology, 3D Bioprinting & tissue engineering, Biodata Analytics, CRISPER CAS 9 Technologies, m-RNA Vaccine design and development, stem cell research and regenerative medicine, computational biology, Nanobiotechnology, SPBT technologies (Small peptide based technologies), Single cell analysis, organoids, metabolic engineering, biosustainable product development and designing, Biopharmaceutical production.

Procedure:

SN	Activities	Responsibilities
1	PG students are decide on thire team members for their semester project with their proposed project domain and title	Project head, PG students
2	Director shall allocate the project guide based on their area of expertise (ot more than 3 batches to a guide)	Director
3	Ensuring that students have regular discussion meetingswith their project guides.	Project guide Project head
4	Synopsis preparation and submission	Project head
5	Verification of student project log book	Project guide Project head
6	Approval of PPT : Abstract,existing, proposed system. 30%of proposed work. 80% of proposed work. 100% of proposed work.	Project guide
7	Preparation and submission of progress report during project	Students Project head
8	Preparaing list for Redo students (insufficient content, plagiarism, poor presentation, genuiene absentees.	Project head
9	Submission of hard copy of project report	Project head
10	Evaluation of project report	External examiner
11	Organizing final project viva-voce	Project heads
12	Ensuring that if a candidate fails to submit the project report on or before the specified deadline , he/she is deemed to havefailed in the project work and shall re – enroll for the same	Project head Project guide Director

SYLLABUS STRUCTURE SHEET

University: MGM University, Chh. Sambhajinagar

Faculty: Basic and Applied Sciences

RESEARCH METHODOLOGY

Institite: Institute of Biosciences and Technology

Degree Program: M.Sc. Biotechnology

Course Code: **Course Title:** Research Methodology

Credits: 4 + 0 (4 Theory + 0 Practicals) **Level of Study: PG**

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

Recommended Year /Semester: M.Sc. Biotechnology

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 fortheproblemunderinvestigation
- 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 DecisionRule, 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 ofHypothesis. 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 Sciences

Post Graduate (PG) Programme

Biotechnology - CURRICULUM

Academic Year 2023-24

M.Sc. Biotechnology

SEMESTER-II

CURRICULUM

Semester II (M.Sc. BT)																		
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	**MBMML110**	**Cell Culture Technology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML111	**Editing life: genetic engineering and synthetic biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML112	**Industrial Biotechnology: Enzymes, Biochemicals and Biomaterials**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMML113	**Bioinformatics and computational Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MBMEP114 MBMEP115	**3. Exploration Biotechnology (Practical) 4. Cell Culture Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MBMEP116 MBMEP117	**3. Biofactory Laboratory (Practical) 4. Bioinformatics Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MBMMJ118	**Micro Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MBFPJ119	**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**

CELL CULTURE TECHNOLOGY

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech. (PG) **Degree:** M.Sc.Biotechnology
Course Unit Code: MBMML110 **Course Unit Title:** Cell Culture Technology
Credits allocated: 3+0 (3Theory+0 Practical) **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Lecture 3 hrs/Week
Recommended Year /Semester : Biotechnology -Master's of Science, Year I/ II Semester
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 Outcomes:

Learn basic techniques and applications of cell culture for biotechnology. 2. Understand the biology of cultured cells and its application in biotechnology. 3. Learn the application of equipment, lab design and lay out, aseptic technique, and safety. 4. Preparation and sterilization of lab equipment, culture vessels, and media. 5. Culture of cell lines and primary cell culture and quantitation of cells. 6. Cell separation, selection, and cloning. 7. Characterization, differentiation and transformation of cells. 8. Contamination, cytotoxicity, and cyropreservation. 9. Specialized cells, organ culture and molecular techniques.

Objectives: On completion of the course, the student should be able to understood Biological principles underlying animal and plant tissue culture and cloning techniques are taught using current cell culture research publications. The formation and maintenance of primary and continuous culture, monolayer and suspension cultures, cell separation techniques, and cell cloning studies are conducted.

Detailed Syllabus

Unit 1 Characteristics of cells in culture **9Hrs.**

Introduction: The use of animal cell culture, Characteristics of cells in culture, Basic equipment and laboratory design: what you need to get started in cell culture, Growth and maintenance of cells in culture, Cell line and culture monitoring, Genetic engineering of animal cells in culture

Unit 2 Mammalian Cell Culture **9Hrs.**

The glycosylation of proteins in cell culture, Hybridomas—sources of antibodies, Scaling up animal cell culture, Modes of culture for high cell densities, Production from cell culture, Mammalian cell products: established and potential.

Unit 3 Animal Cell Cultures Techniques **9Hrs.**

History of animal cell culture; Different tissue culture techniques; Cell separation, disaggregation of the explants, mechanical and enzymatic disaggregation; Continuous cell lines; Organ culture, techniques, advantages, disadvantages, applications; Cell cultures, substrate culture and suspension culture; Primary cell culture; Secondary cell culture (cell lines); Development, characterization and maintenance of cell lines, Cryopreservation; Commercial scale production of animal cells; stem cells- fate mapping, application; Application of animal cell culture for in vitro testing of drugs;

Unit 4 Plant Cell Culture Techniques 9Hrs.

Cellular Totipotency, And its Applications. Organogenesis, factors affecting organogenesis. Cytodifferentiation. Somatic Embryogenesis, Synthetic Seeds, Techniques for production of haploids, diploidization, production of double haploids and their Applications. Triploids production - Endosperm culture and Applications. Secondary metabolite production, selection of high yielding lines, elicitation, immobilization of cultures, hairy root culture and biotransformation. Factors affecting secondary metabolites, industrial application of secondary metabolites. Molecular farming.

Unit 5 Microbial Cell Culture Techniques 9Hrs.

Auxotroph isolation - replica plating technique, Screening Preservation of microbial products. Production of antibiotics. Enumeration and screening of novel microbial secondary metabolites, strain improvement, Use of microbes in industrial waste treatment. Microbial leaching.

Suggested Reading/ Reference Books/ Text Books

1. Plant Cell Culture: A Practical Approach R.A. Dixon & Gonzales IRL Press 1994

2. Culture of animal cells-A manual of basic technique and specialized applications R. Ian Freshney Wiley Blackwell publishers 1983

3. Microbial Biotechnology Alexander N Glazer, Hiroshi Nikaido W H Freeman & Company 1995

4. Living resources for Biotechnology, Animal cells Doyle, R. Hay and B.E. Kirsop Cambridge University Press 1990

5. Plant Tissue Culture Sathyanarayana B N, IK Intl. Publishers 2007

6. Principle of Microbe & Cell Cultivation SJ Prit Blackwell Scientific co 1975

7. Animal Cell Culture and Technology THE BASICS Garland Science Michael Butler

EDITING LIFE: GENETIC ENGINEERING AND SYNTHETIC BIOLOGY

University: MGM University, Aurangabad **Faculty:** Microbiology

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

Course Unit Code: MBMML111 **Course Unit Title:** Editing Life: Genetic Engineering and Synthetic biology

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

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

Recommended Year /Semester: Biotechnology -Master's of Science, Year I/ II Semester

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 Outcomes:

1. Describe, illustrate and apply different techniques in the fields of genomics and transcriptomics.
2. Describe, illustrate and apply different techniques used for high-throughput molecular biology studies
3. Report orally and in writing within the subject
4. Review and give constructive feedback on the reports within the subject
5. Explain the theory of state-of-the-art tools/algorithms for processing data from high- throughput molecular biology experiments
6. Choose and use appropriate methods and tools for processing data from high-throughput molecular biology experiments
7. Describe how naturally occurring organisms regulate the expression of their genes
8. Describe how the regulation of the genes and properties of gene products can be altered with synthetic biology methods used during the course
9. Describe how synthetic biology alters the properties of the cell or the organism
10. Apply a scientific approach to the planning, execution, reporting and interpretation of advanced projects with the aim at creating replicating systems with new properties that can be regulated, and to critically analyse the results and generate testable hypotheses from these experiment.
11. Critically analyse, present and defend scientific literature in synthetic biology, including practical applications such as biofuel and metabolic engineering
12. Develop ethical perspectives in synthetic biology

Objectives:

It aims at the (re-)design and fabrication of biological components and systems that do not already exist in the natural world. Synthetic biology combines chemical synthesis of DNA

with growing knowledge of genomics to enable researchers to quickly manufacture catalogued DNA sequences and assemble them into new genomes.

Detailed Syllabus

Theory

UNIT 1 Molecular Techniques 9Hrs.

PCR Techniques- Principle of polymerase chain reaction (PCR) - Components of PCR reaction and optimization of PCR -Gene specific primer and degenerate primer – Inverse PCR, Hot-start PCR, Loop mediated PCR -, Reverse transcription PCR and Real time PCR. Chemistry of primer synthesis. Hybridization methods-Probes – Labelling of probes-Radioactive and non-radioactive probes - Detection techniques, Southern hybridization, Northern hybridization, Western blotting

DNA Sequencing methods- Sanger's method of DNA sequencing – Manual and automated methods. Pyrosequencing – massively parallel 454-sequencing, Illumina sequencing, SOLiD sequencing, single molecule sequencing.

Protein Sequencing methods-Electrophoresis of protein – native and denaturing conditions, capillary and gel electrophoresis, 2D gel electrophoresis, ELISA, yeast hybrid system – one hybrid system – two hybrid system, phage display.

UNIT II Molecular tools for Gene Cloning 9Hrs.

Restriction enzymes – Introduction and types with examples, methylation sensitivity of restriction enzymes Dam, Dcm and CpG methylases, star activity of restriction enzymes, . modifying enzymes, DNA and RNA polymerases, reverse transcriptase, terminal transferase, DNA/RNA modifying enzymes-methylases-CpGmethylase (M.Sss I), dam methylase, M.EcoR I.

Introduction to cloning vectors, plasmid biology, plasmid vectors (high copy and low copy), phage biology, phage vectors, cosmid vectors, phasmid vectors, BAC vectors and YAC vectors, yeast vectors.

Construction of Gene Libraries-Construction of cDNA library- construction subtractive cDNA library – construction of genomic DNA library – BAC library – YAC library.

UNIT III Cloning Techniques 9Hrs.

RFLP, DNA fingerprinting and foot printing, chromosome walking, marker techniques.

Gene cloning strategies, cloning in bacteria other than E Coli, Cloning in Saccharomyces cerevisiae and other fungi, Gene transfer to animal cells, Genetic manipulation of animal.

Cloning after restriction digestion - blunt and cohesive end ligation – creation of restriction sites by PCR- cloning using linkers and adapters - cloning after homopolymer tailing. Cloning Technologies Strategies for cloning PCR products – TA cloning -TOPO-TA cloning-Ligation free cloning. Bio Brick cloning, Restriction Enzyme Cloning, Gateway recombination cloning, Topo cloning / TA, Gibson Assembly, Type II S Assembly, Global Gate/Moc, Ligation independent cloning, Peast mediated cloning & oligonucleotide stitching, PCR cloning, Seamless cloning, Recombinational cloning, Gateway cloning, Infusion cloning, BI/ multi-cistronic Cloning.

UNIT IV Expression methods & Synthetic Biology 9Hrs.

Basics of Gene expression – hybridization techniques, Northern blot analysis, Primer extension, S1 mapping, RNAase protection assays, Reporter assays), Nucleic acid microarrays. Gene expression in bacteria and Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants – characterization of recombinant proteins, stabilization of proteins; Phage display, Yeast Two- and three Hybrid system.

Expression of Recombinant Proteins-Construction of expression vectors for bacteria and yeast Construction of expression vectors for plants and animal cells. Bias in codon use and codon optimization.

Methods of Plant Transformation-Biology of Agrobacterium tumefaciens- plant transformation methods - stable and transient -Agrobacterium-mediated, biolistic, PEG/ liposome-mediated, electroporation, chloroplast transformation, protoplast transformation, site directed integration of transgene (zinc finger).

Plant Transformation Vectors-Binary and co-integrate vectors- gateway vectors - promoters - selectable and screenable markers - marker free transgenics -significance and applications.

Noise in gene expression: Origin, propagation, consequences, and control, Robustness and evolvability of genetic networks, Bacterial circuits: Toggle switch and repressilator Instructor out of town, Bacterial circuits: Feedback, feed-forward, signal propagators, and band filter, Bacterial communication circuits: Population control and patterning systems, Bacterial communication circuits: Synchronized oscillators, Functional synthetic systems: From modules to systems, Gene circuit design and engineering: Biobricks/BioFAB and designing softwares, Synthetic circuits beyond bacteria: Phage, virus, and eukaryotes

UNIT V Advance Gene Technologies & RNA Engineering 9Hrs.

Genome-Editing Technologies: Principles and Applications, RNA Interference: Biology, Mechanism, and Applications, Genome editing with engineered zinc finger nucleases, CRISPR-Cas: biology, mechanisms and relevance, TALEN Genome-Editing System, Meganucleases,

Introduction-- Amplify aptamer-encoding DNA, SELEX I: Building a Library-Purify aptamer- encoding DNA, SELEX II: Selecting RNA with target functionality-Prepare RNA by IVT, SELEX III: Technical advances & problem-solving--Purify RNA and run affinity column, Characterizing aptamers--RNA to DNA by RT-PCR, Introduction to porphyrins: chemistry & biology--, Aptamer applications in biology & technology--Aptamer binding assay, Aptamers as therapeutics Introduction--Start-up biomaterials engineering, Introduction to biomaterials; cartilage composition--Initiate cell culture.

Suggested Reading/ Reference Books/ Text Books

1. Principles of Gene Manipulation and Genomics(link is external) – 7th Edition – Sandy B.
2. Primrose, Richard Twyman – Blackwell Publishing
3. Gene Cloning and DNA Analysis: An Introduction(link is external) - 6th Edition - T. A.
4. Brown - John Wiley & Sons
5. An Introduction to Genetic Engineering (link is external) - 3rd Edition - Desmond S. T.
6. Nicholl - Cambridge University Press
7. Molecular Biotechnology: Principles and Applications of Recombinant DNA (link is external)- 4th Edition - Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten - ASM Press
8. Synthetic Biology: Tools and Application by Huimin Zhao
9. Bioengineering: A conceptual Approache by Mirjana Pavlovic
10. Synthetic biology: a lab manual by *Liljeruhm, Josefine; Gullberg, Erik; Forster, Anthony C.*
11. Uri Alon, an Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC (2006).
12. Eric Davidson, The Regulatory Genome: Gene Regulatory Networks In Development And
13. Evolution, Academic Press (2006).
14. Hamid Bolouri, Computational Modeling Of Gene Regulatory Networks - A Primer, Imperial College Press (1st edition) (2008).
15. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter
16. Walter, Molecular Biology of the Cell, Garland Science (4th edition) (2002).
17. Robert Brooks Phillips, Jane Kondev and Julie Theriot, Physical Biology of the Cell, Garland Science (1st edition) (2008).
18. Mark Ptashne and Alexander Gann, Genes and Signals, Cold Spring Harbor Laboratory Press (1st edition) (2001)

INDUSTRIAL BIOTECHNOLOGY: ENZYMES, BIOCHEMICALS AND BIOMATERIALS

University: MGM University, Aurangabad **Faculty:** Basic & Applied Sciences

Institute: Institute of Biosciences and Technology. **Degree:** M. Sc. Biotechnology (PG)

Course Unit Code: MBMML112

Course Unit Title: Industrial Biotechnology: Enzymes, Biochemicals and Biomaterials

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

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

Recommended Year /Semester: Biotechnology Masters of Science, Year I/ 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 post graduate life science.

Learning outcomes: After completion of this course, students are expected to learn/understand the basic concept and biotechnological significance of microbial enzyme.

Objectives: The objective of this course is to provide detailed knowledge of biotechnology of microbial enzymes. This course is useful for those students who wish to build their career in biotechnology industries specifically those industries where products are synthesized from microbial source

Detailed Syllabus

Theory

Unit 1:Enzymes with its types **9Hrs.**

Enzymes, Classification and types of reaction and Their Use, selection of enzymes in industrial processes

Amylase: its types and uses, Bacterial amylase, fungal amylase, detail application of amylase in different industry,

Lipases: fungal lipases and bacterial lipases with its applications.

Unit 2: Therapeutic enzymes **9Hrs.**

Some common enzymes found in different species, Problems, Safety Concerns, and Possible Future Strategy to Outcome.

Therapeutic enzymes: mechanism of action, Application of therapeutic enzymes in different disorders and diseases

Unit 3: Microbial enzymes **9Hrs.**

Modern Application of Enzyme: A Biotechnology View: A broad spectrum idea about using the application of enzymes in different areas.

A summarized overview of some microbial enzymes with special characteristics of industrial importance viz. Protease, Keratinase, Xylanase, Ligninase, Cellulase.

Unit 4:Applications and production of Microbial Enzyme **9Hrs.**

Commercial microbial enzyme production, Detergent enzymes, Starch processing enzymes, Enzymes in cheese production, Enzymes in plant juice production, Enzymes in textile manufacture, Enzymes in leather manufacture, Enzymes used in the treatment of wood pulps, Enzymes as catalysts in organic synthesis, Fermentation for Enzyme Production, Enzyme Extraction, Packaging and Finishing, Toxicity Testing and Standardization

Unit 5:Immobilized Biocatalysts: Enzymes and Cells **9Hrs.**

General Advantages of Immobilized Biocatalysts, Methods of Immobilizing Enzymes, Methods for the Immobilization of Cells. Bioreactor Designs Used in Biocatalysts, Practical Application of Immobilized Biological Catalyst Systems, Manipulation of Microorganisms for Higher Yield of Enzymes: Biological Aspects of Extracellular Enzyme Production

Suggested Reading/ Reference Books/ Text Books

1. Enzyme Kinetics (2009) Palmer
2. IUPAC Enzyme nomenclature series.
3. General Enzymology :Kulkarni & Deshpande
4. Enzyme Assays:J. Raymond
5. Biochemistry: Voet and Voet
6. Lehninger Principles of Biochemistry by Nelson, Cox
7. Fundamentals of Enzymology Third edition, Nicholas C. Price and Lewis Stevens

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

University: MGM University, Aurangabad **Faculty:** Basic & Applied Sciences

Institute: Institute of Biosciences and Technology. **Degree:**M.Sc.Biotechnology (PG)

Course Unit Code: MBT-124 **Course Unit Title:** Bioinformatics and computational 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: Biotechnology -Master's of Science, Year I/ II Semester
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 Outcomes:

knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. Existing software effectively to extract information from large databases and to use this information in computer modelling.

Objectives: On completion of the course, the student should be able to know about Computational biology and bioinformatics is an interdisciplinary field that develops and applies computational methods to analyse large collections of biological data, such as genetic sequences, cell populations or protein samples, to make new predictions or discover new biology.

Detailed Syllabus

Theory

Unit 1: Analysing DNA, RNA and Protein Sequences
Introduction, Genome wide Analysis of DNA, RNA, and Protein, Access to Sequence Data and Related Information, Pairwise Sequence Alignment, Basic Local Alignment Search Tool (BLAST), Advanced Database Searching.

Unit 2: Genome wide Analysis of DNA, RNA, and Protein
Multiple Sequence Alignment, Molecular Phylogeny and Evolution
DNA: The Eukaryotic Chromosome, Analysis of Next-Generation Sequence Data, Bioinformatic Approaches to Ribonucleic Acid (RNA).

Unit 3: Genome Analysis
Gene Expression: Microarray and RNA-seq Data Analysis, Protein Analysis and Proteomics,

Protein Structure, Functional Genomics Genomes across the Tree of Life, Completed Genomes: Viruses.

Unit 4: Human Genome
Completed Genomes: Bacteria and Archaea, Eukaryotic Genomes: Fungi, Eukaryotic Genomes: From Parasites to Primates, Human Genome, Human Disease.

Unit 5: Proteomics
Introduction to Proteomics, Protein 2d and 3d structure, Molecular modeling and types, docking

Suggested reading:
1. Bioinformatics and Functional Genomics Third Edition by Jonathan Pevsner Department of Neurology, Kennedy Krieger Institute, Baltimore, Maryland, USA
2. Bioinformatics for Biologists by Pavel Pevzner University of California, San Diego, USA AND Ron Shamir Tel Aviv University, Israel

EXPLORATION BIOTECHNOLOGY

University: MGM University, Aurangabad

Faculty: Basic & Applied Sciences

Institute: Institute of Biosciences and Tech.

Degree: M.Sc. Biotechnology

Course Unit Code: MBMEP114

Course Title: Exploration Biotechnology

Credits allocated: 0+2

Level of Study: PG

Mode of delivery, planned learning activities and teaching method: Practical 6 hrs weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ SemesterII

Practical List:

1. Production of Alpha amylase from bacterial sources
2. Identification of Alpha Amylase from Iodine and Starch agar plate
3. Dialysis of Alpha Amylase sample
4. SDS of Alpha Amylase Sample
5. Silver Staining of Alpha Amylase Sample
6. Production of protease enzyme
7. Detection of Protease enzyme
8. Identification of Protease enzyme
9. Ethanol Production
10. Detection of ethanol
11. To study NCBI
12. To study Protein Data Bases
13. To study Nucleotide Data Bases
14. To study Gene Bank
15. To study Pubmed

CELL CULTURE LAB

University: MGM University, Aurangabad **Faculty:** Basic & Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Biotechnology

Course Unit Code: MBMEP115 **Course Title:** Exploration Biotechnology

Credits allocated: 0+2 **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 6 hrs weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ SemesterII

Practical List:

- Protocol for proper lab attire and personal protective equipment (PPE)
- Aseptic technique protocol for working in a laminar flow hood
- Protocol for cleaning and sterilizing cell culture equipment
- Preparation of common cell culture reagents (e.g., media, buffers)
- Protocol for passaging adherent cells using trypsinization
- Guidelines for determining optimal cell density and subculturing ratios
- Protocol for maintaining suspension cells through regular passaging and monitoring of viability
- Techniques for counting and adjusting cell density in suspension cultures
- Protocol for tissue dissociation and isolation of primary cells
- Guidelines for optimizing culture conditions and media composition
- Methods for assessing cell viability, morphology, and differentiation markers
- Protocol for immunocytochemistry staining to confirm specific cell types
- Protocol for cell counting using a hemocytometer and trypan blue staining
- Calculation of cell density and viability
- Trypan Blue Exclusion Assay for Cell Viability:
- Protocol for assessing cell viability based on trypan blue dye exclusion
- Determination of live and dead cell percentages

BIOFACTORY LABORATORY

University: MGM University, Aurangabad **Faculty:** Basics & Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Biotechnology

Course Unit Code: MBMEP 116 **Course Unit Title:** Biofactory Laboratory

Credits allocated: 0+2 **Level of Study:** PG

Mode of delivery, planned learning activities and teaching method: Practical 6 hrs weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development
Recommended Year /Semester: Biotechnology, Year I/ SemesterII

Practical List:

1. Counting Cells in a Hemocytometercounter.
2. Counting Cells in a Countess II following TrypLE reagent cell dissociation: How to count cells using TrypLE reagent and an automated cell counter.
3. Growth Factor Supplementation for Specific Cells: Reference Chart
4. Recommended Sera Supplementation for Advanced Media: See serum supplementation recommendations for Advanced media, including Advanced DMEM/F-12, Advanced RPMI 1640, Advanced DMEM, and Advanced MEM.
5. Guidelines for Maintaining Cultured Cells: Learn what is subculture and when to do it, review media recommendations for common cell lines and how to dissociate cells as well as the benefits of using Gibco TrypLE as an alternative to trypsin.
6. Media Preparation from Powder and Concentrates
7. Subculturing Adherent Cells: A general procedure for subculturing adherent mammalian cells in culture.
8. Subculturing Suspension Cells: A general procedure for subculturing mammalian and insect cells in suspension culture.
9. Freezing Cells: A general procedure to properly cryopreserving cell lines.
10. Thawing Frozen Cells: Trypan Blue Exclusion:Use of Antibiotics and Antimycotics
11. Useful Numbers for Cell Culture
12. Red Blood Cell Lysis Using ACK Lysing Buffer
13. To study Lac Operon Mechanism
14. To study Tryptophan Operon

15. To study Competent Cell
16. To study Blue white screening
17. To study Positive regulation of gene
18. To study Negative regulation of gene
19. To study mechanism of Replica plating

Preparing Salts Solutions from Powder Concentrates

BIOINFORMATICS LAB

University: MGM University, Aurangabad **Faculty:** Basics & Applied Sciences

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

Course Unit Code: MBMEP117 **Course Unit Title:** Bioinformatics Lab

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

Mode of delivery, planned learning activities and teaching method: Practical 6hrs weekly

Objective: To elaborate the Lab Performance for future Practical Skill Development

Recommended Year /Semester: Biotechnology, Year I/ Semester II

Practical List:

1. Sequence retrieval from NCBI
2. Study of UCSE genome browser
3. Local sequence alignment
4. Global sequence alignment
5. Multiple sequence alignment
6. Phylogeny
7. Introduction to galaxy
8. Fastq sequence retrieval
9. Quality control of Fastq sequence
10. Prosite
11. MEME
12. Restriction mapping
13. Homology modeling
14. Structure retrieval from protein data bank & pubchem
15. Docking

MICRO PROJECT

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Technology **Degree:** M.Sc. Biotechnology (PG)

Course Unit Code: MBMMJ118 **Course Unit Title:** Micro Project

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

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

Recommended Year /Semester: Biotechnology 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.

Candidates should pass in undergraduate Life Science.

Course Outcomes:

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

Research Thrust Areas:

Plant tissue culture, Molecular biology, Data interpretation, Mycology, Microbiology, Quantitative and qualitative experimental research, Synthetic biology, 3D Bioprinting & tissue engineering, Biodata Analytics, CRISPER CAS 9 Technologies, m-RNA Vaccine design and development, stem cell research and regenerative medicine, computational biology, Nanobiotechnology, SPBT technologies (Small peptide based technologies), Single cell analysis, organoids, metabolic engineering, biosustainable product development and designing, Biopharmaceutical production.

Procedure:

SN	Activities	Responsibilities
1	PG students are decide on thire team members for their semester project with their proposed project domain and title	Project head, PG students
2	Director shall allocate the project guide based on their area of expertise (ot more than 3 batches to a guide)	Director
3	Ensuring that students have regular discussion meetingswith their project guides.	Project guide Project head
4	Synopsis preparation and submission	Project head
5	Verification of student project log book	Project guide Project head
6	Approval of PPT : Abstract,existing, proposed system. 30%of proposed work. 80% of proposed work. 100% of proposed work.	Project guide
7	Preparation and submission of progress report during project	Students Project head
8	Preparaing list for Redo students (insufficient content, plagiarism, poor presentation, genuiene absentees.	Project head
9	Submission of hard copy of project report	Project head
10	Evaluation of project report	External examiner
11	Organizing final project viva-voce	Project heads
12	Ensuring that if a candidate fails to submit the project report on or before the specified deadline , he/she is deemed to havefailed in the project work and shall re – enroll for the same	Project head Project guide Director

Ideas of project:

Defining projects ideas is crucial for setting realistic expectations and laying out a clear vision for a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.

Literature survey:

A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation.

Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.

1.Implementation:

Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.

2.Evaluation:

Clearly relates solution to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.

3.Project Log:

1. Use the data analysis tools for findings
2. The individual and group activity (2-3 – Discussion with project coordinator) student's effort and commitment.
3. The quality of the work produced by the individual student.
4. The student's integration and co-operation with the rest of the group.
5. The completeness of the logbook & time to time signature of guide

FIELD PROJECT

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science

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

Course Unit Code: MBFPJ119 **Course Unit 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.

Course 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.

Ideas of project:

Defining project ideas is crucial for setting realistic expectations and laying out a clear vision for a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.

Literature survey:

A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation. Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.

Performance:

Performance measurement during a project is to know how things are going so that we can have early warning of problems that might get in the way of achieving project objectives and so that we can manage expectations. The criteria of it as given below.

3. Implementation:

Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.

4. Evaluation:

Clearly relates to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.

5. Project Log:

a. The individual student's effort and commitment.

b. The quality of the work produced by the individual student.

c. The student's integration and co-operation with the rest of the group.

d. The completeness of the logbook & time to time signature of guide

Objective: To elaborate the procedure for Guiding Student projects

Responsibility:

- All the Project Guide.
- All Semester B.Sc. students
- Project Heads

PROCEDURE

SN	Activities	Responsibilities
1	PG students are decide on their team members for their semester project with their proposed project domain and title	Project head, PG students
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