MGM UNIVERSITY, AURANGABAD

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE-BASED CREDIT SYSTEM(CBCS) SEMESTER PATTERN

Faculty of Basic and Applied SciencesGraduate (UG) Program

Biotechnology - CURRICULUM

W.e.f. **Academic Year 2023-24**

B.Sc., B. Sc. (Hons.), B. Sc. (Hons.) with Research of Biotechnology

SEMESTER (I,II)

Prepared By

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Submitted By

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Approved By

Board of Studies

B.Sc., B. Sc. (Hons.), B. Sc. (Hons.) with Research of Biotechnology

CURRICULUM

Academic Year 2023-24

B.Sc., B. Sc. (Hons.), B. Sc. (Hons.) with Research of Biotechnology

FIRST YEAR

(SEMESTER I)

MGM University
Chhatrapati Sambhajinagar– 431003
(Template format as per discussion at 14/05/2023)

Name of the College/Institute: Institute of Bioscience and Technology **Faculty of** Basic and Applied SciencesGraduate (UG) Program
Name of the Program :**(3/4 Years UG program)**B.Sc./B.Sc. Hons./B.Sc. Hons with Research
Program Type: UG/ B.Sc./B.Sc. Hons./B.Sc. Hons with Research **Duration: - 04 Years (08 Semesters)**

Level				**First Year (Semester I)**																		
	Course Type	**Course code**	**Course Title**	**Type**	**Teaching period per week (Hrs /week)**			**Credits**	**Duration of Exam**	**Evaluation Scheme (Marks)**							**Minimum Passing (Marks)**					
										Internal				**External**		**Total**	**Internal**		**External**		**Total**	
					L	**T**	**P**			**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**		**CA/MSE/TW**		**ESE**	**PR**	
	Core	BBMML101	Bacterial Biological Diversity	Theory	3			3		20	20	20	-	40	-	100			16		40	
	Core	BBMML102	Bioinstrumentation	Theory	2		-	2		10	10	10	-	20	-	50			8	-	20	
	IKS		Annexure I	Theory	2		-	2		10	10	10	-	20	-	50			8	-	20	
	AEC		Communicative English I	Theory	2	-	-	2		10	10	10	-	20	-	50			8		20	
4.5	OE**	BBOEL103	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50			8		20	
	OE	BBOEL104	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50			8		20	
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50			8		20	
	VSC*	BBVSP105	BT Lab I	Practical			4	2					30		20	50				8	20	
	SEC*	BBSEP106	Explorations in Biotechnology –I	Practical			4	2					30		20	50				8	20	
	Core	BBMMP107	Bio-Skills Lab Factory-I	Practical	-	-	2	1			-		30	-	20	50				8	20	
	CC		Annexure I	Practical		-	4	2			-		30	-	20	50				8	20	
	Total (L-T-P) Hrs / week = 29				**15**		**14**	**22**														

Level				**First Year (Semester II)**																		
	Course Type	**Course code**	**Course Title**	**Type**	**Teaching period per week**			**Credit**	**Duration of Exam**	**Evaluation Scheme**							**Minimum Passing**					
										Internal				**External**		Total	**Internal**		**External**		**Total**	
					L	**T**	**P**			**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**		**CA/MSE/ TW**		**ESE**	**PR**	
	Core	BBMML108	Biomolecules and Bioenergetics	Theory	2			2		10	10	10	-	20	-	50			8		20	
	Core	BBMML109	Biology: Concept, Connections, Investigation and applications	Theory	3		-	3		20	20	20	-	40	-	100			16		40	
4.5	MIN	BBMIL110	Annexure I	Theory	2		-	2		10	10	10	-	20	-	50			8		20	
	AEC		Communicative English II	Theory	2	-	-	2		10	10	10	-	20	-	50			8		20	
	OE**	BBOEL111	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50			8		20	
	OE	BBOEL112	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50			8		20	
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50			8		20	
	VSC*	BBVSJ113	BT Lab II	Practical			4	2					30	20	50					8	20	
	SEC*	BBSEP114	Explorations in Biotechnology –II	Practical			4	2					30	20	50					8	20	
	Core	BBMMP115	Bio-Skills Lab Factory-II	Practical	-	-	2	1			-		30	-	20	50				8	20	
	CC		Annexure I	Practical	-	-	4	2			-		30	-	20	50				8	20	
	Total (L-T-P) Hrs / week = 29				**15**		**14**	**22**														

*As per the requirement VSC / SEC can be used for Theory or Practical of core subject **As per the requirement, Department/Institute can offer OE practical

Level 4.5 Award of UG certificate with 44 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Level				First Year (Semester I)																	
	Course Type	Course code	Course Title	Type	Teaching period per week (Hrs /week)			Credits	Duration of Exam	Evaluation Scheme (Marks)							Minimum Passing (Marks)			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	TW	ESE	PR		CA/MSE/TW	ESE	PR	
4.5	Core	BBMML101	Bacterial Biological Diversity	Theory	3			3		20	20	20	-	40	-	100		16		40
	Core	BBMML102	Bioinstrumentation	Theory	2		-	2		10	10	10	-	20	-	50		8	-	20
	IKS		Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		8	-	20
	AEC		Communicative English I	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	OE**	BBOEL103	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	OE	BBOEL104	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	VSC*	BBVSP105	BT Lab I	Practical			4	2					30		20	50			8	20
	SEC*	BBSEP106	Explorations in Biotechnology –I	Practical			4	2					30		20	50			8	20
	Core	BBMMP107	Bio-Skills Lab Factory-I	Practical	-	-	2	1			-		30	-	20	50			8	20
	CC		Annexure I	Practical		-	4	2			-		30	-	20	50			8	20
	Total (L-T-P) Hrs / week = 29				**15**		**14**	**22**												

BBMML101 BACTERIAL BIOLOGICAL DIVERSITY 3+0

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc. (Hons/Hons. with research) Biotechnology

Course Unit Code: BBMML101 **Course Unit Title:** Bacterial Biological Diversity

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

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives:

1. To study the Basic concepts of microbiology & microorganisms.
2. To understand the characters of prokaryotic and Eukaryotic microorganisms for conventional
3. and molecular characterization using modern methods.
4. Knowledge of cellular organization, life cycle and economic importance of bacteria

Course Outcomes:

By the conclusion of this course, the students –

1. Have developed a good knowledge of the development of the discipline of Microbiology andthe contributions made by prominent scientists in this field.
2. Have developed a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.
3. Are able to explain the useful and harmful activities of the microorganisms.
4. Are able to perform basic experiments to grow and study microorganisms in the laboratory.

Detailed Syllabus:

Unit 1 Prokaryotic and Eukaryotic cell (Lectures 07)

Prokaryotic and Eukaryotic cell differential account, Binomial nomenclature concept, Whittekar's five kingdom system, Carl woeses three kingdomsystem, Baltiomore classification.

Unit 2 General characters, Bacterial cell – organization and structure (Lectures 11)

General characters of Bacteria, Fungi, algae, actinomycetes, mycoplasma, rickettsia, archaea, protozoa. Morphology of acellular microorganisms (Viruses, Viroids, Prions)

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Difference between gram positive and gram-negative cell walls, Cell membrane, Ribosomes, mesosomes, chromosome, plasmids and endospore: structure and stages of sporulation. Archaebacterial cell wall and acid fast bacterial cell wall,

Unit 3 Methods of studying microorganism (Lectures 11)

Methods of studying microorganism; Staining techniques: simple staining, Gram staining and acid-fast staining. Sterilization techniques (physical & chemical sterilization). Culture media & conditions for microbial growth. Growth curve of bacteria. Pure culture isolation: Streaking, serial dilution and plating methods. Maintenance and preservation of pure cultures.

Unit4 Identification and Bacterial diversity (Lectures 08)

Classification of bacteria according to the Bergey's Manual of Systematic Bacteriology. Numerical taxonomy. Modern methods of studying bacterial diversity.

Unit 5 Role of microbes (Lectures 08)

Role of microorganisms in different fields as agriculture, human health, industry, food processing.

Reference Books and Text Books

1. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB Mc Graw Hill,New York, (2002).
2. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An Introduction. Pearson Education,Singapore, (2004).
3. Alcomo, I.E. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers.Sudbury. Massachusetts, (2001).
4. Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York, (2002).
5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
6. Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication
7. Tortora, Funke, Case. Microbiology. Pearson Benjamin Cummings.
8. Jacquelyn G. Black. Microbiology Principles and Explorations. John Wiley & Sons, Inc.
9. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson 10.

BBMML102 **Bioinstrumentation** **2+0**

University: MGM University, Aurangabad

Faculty: Basic and applied science

Institute: Institute of Biosciences and Tech.

Degree: B.Sc Hons Biotechnology

Course Unit Code: BBMML102

Course Unit Title: Bioinstrumentation

Credits allocated: 2+0(Theory)

Level of Study: UG

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objective

1. Students will develop a conceptual understanding of connections between physics and biology.
2. Students will be able to explain the behavior and interactions between, matter and energy at both the atomic and molecular levels by different atomic models.
3. Students will gain an understanding of interpreting spectra and will be able to explain how spectroscopic methods are used for quantitative analysis of biomolecules.

Course Outcome

Upon successful completion of this subject student should be able to acquire a deep knowledge in:

1. Students will be able to handle various equipment's used in biochemical analysis and troubleshoot them.
2. Students will be able develop competence in handing various chromatographic techniques and apply them in isolating and characterizing different biological molecules.
3. Understanding the applications of centrifugation and chromatography in biological investigations.
4. Discuss the applications of biophysics and principle involved in bioinstruments
5. Describe the methodology involved in biotechniques
6. Describe the applications of bioinstruments
7. Demonstrate knowledge and practical skills of using instruments in biology and medical

Detail Syllabus

Unit 1 General Biophysical methods (7 lectures)

Measurement of pH, Radioactive labeling & counting, Separation & Identification of Materials - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

Unit 2 Centrifugation (7 lectures)

Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugationof associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation.

Unit 3 Microscopy and Crystallography (7 lectures)

Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, PhaseContrast microscopy, TEM, SEM. X-Ray Crystallography – X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure[concept of rotating crystal method, powder method].

Unit 4 Spectroscopy (09 lectures)

Spectroscopy: Raman Spectroscopy – What is Raman effect, Quantum mechanical reason of Raman effect, Basic concept of pure Rotational & Vibrational, Raman spectra of simple molecular (linear molecules).NMR Spectroscopy- Basic principle of NMR Spectroscopy, Absorption spectroscopy- simple theory of the absorption of light by molecules, Beer-lambert law, Instrumentation for measuring the absorbance of visible light, factor affecting the absorption properties a chromophore.

REFERENCES

1) Biophysical Chemistry 2020 by Nath and Upadhya.

2) Practical biochemistry principles and techniques by Wilson and Walker.

3) Instrumental methods of chemical analysis by Chatwal and Anand.

4) Lab Manual in Biochemistry by J. Jayaraman

5) Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.

6) Analytical Biochemistry by Holme.

7) Spectroscopy by B.P. Straughan and S. Walker

8) Introduction to HPLC by R.J. Hamilton and P.A. Sewell

9) A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.

10) Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.

11)Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York. 7. Analytical Biochemistry by Holme.

12)Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A. Sewell.

13) Spectroscopy by B.P. Straughan and S. Walker.

14) Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.

15). Gel Chromatography by Tibor Kremmery. Wiley Publications.

16) Gel Electrophoresis of Proteins- A Practical Approach by Hanes.

BBVSP105 **BT Lab - I** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied science

Institute: Institute of Biosciences and Tech. **Degree: B.Sc Hons.** Biotechnology

Course Unit Code: BBVSJ105 **Course Unit Title:** Micro Project- I

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

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

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

Course Objective:

1. The purpose of the mini-project is to allow you to explore the breadth of research that is being performed within the college.

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

Course 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.

Thrust Area of Project:

1. Molecular biology,
2. Molecular breeding,
3. Molecular diagnostics,
4. Recombinant DNA technology,
5. Plant tissue culture & genetic transformation,
6. Genomics & proteomics,
7. Bioinformatics**.**
8. Fermentation Technology

BBSEP106 **Explorations in Biotechnology-I** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. Biotechnology **Degree**: B.Sc (Hons/Hons. with research).

Course Unit Code: BBSEP106 **Course Unit Title:** Biotechnology Exploration Program

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

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives

1. To unable students with different skills for preliminary needed skills for project designing and development
2. To aware student for understand market and their problem
3. To explore and aware the students for finding the solution on different problems

Course Outcomes

As an outcome of completing the course, students will able to

1. Explain the role bioscience scientist as a problem solver
2. Identify multi-disciplinary approach required in solving as biosciences problem
3. Build simple systems using biotechnology and bioinformatics
4. Analyses biosciences solutions from ethical perspectives.
5. Analyses biosciences solution from sustainability perspectives.
6. Use basics of science project management skills in doing projects.
7. Demonstrate data acquisition and analysis skills using a tool.

Practical's-

1. Sterilization: principles & operations –
    - Autoclave
    - Hot Air Oven
    - Laminar Air Flow
2. Principles & operations of Incubators & Shaker,

3. Principles & operations of centrifuge
4. Principles & operations of Colorimeter Spectrophotometer.
5. To determine the PH of the given sample using PH paper or Universal Indicator.
6. Survey of Cell Types: Structure and Function
7. Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa)
8. Preparation of dilute solutions by serial dilution from- (Soil, Air &; Water)
9. Methods of Isolation of bacteria from different sources.
10. To Perform Simple Staining.
11. Differential Staining: Gram Staining
12. To study the Species Diversity
13. Collection of different seeds and classification**.**
14. Thin layer chromatography
15. Paper Chromatography of Sugars /lipids
16. Blood group analysis.
17. Estimation of ascorbic acid
18. Water analysis.
19. Hays test for bilirubin
20. Heat coagulation Albumin and Globulin
21. Enzyme activity of serum alkaline phosphatase
22. Isolation of Rhizobium from root nodules and its confirmation
23. Isolation of Azotobacter from soil on N2 free medium

BBMMP107 **Bio-Skills Lab Factory-I** **0+1**

University: MGM University, Aurangabad **Faculty:** Basic and applied science

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc Hons. Biotechnology

Course Unit Code: BBMMP107 **Course Unit Title:** Bio-skills Lab Factory-I

Credits allocated: 0+1 **Level of Study:** UG

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives:

1. To explore students with hands on laboratory techniques
2. To unable students for different skills sets
3. To acquire students Lab etiquettes
4. Applying principles of lab safety.
5. Keeping accurate records with sufficient information to reproduce what was done.
6. Preparing aqueous solutions of varying composition.
7. Applying core principles of cell and molecular biology.
8. Applying core principle of centrifugation and spectrophotometry.
9. Preparing microbiological media and applying aseptic technique in the culturing of microorganisms.
10. Oral and written communication, maintaining a professional work ethic, and working well with others.

Course Outcomes

1. Examine and apply the fundamentals of cellular and molecular biology concepts to biotechnology research and its practical applications.
2. Develop and maintain laboratory records according to standard scientific and industrial guidelines.

3. Employ mathematical skills and knowledge of chemistry to accurately prepare an aqueous solution with the desired chemical concentrations and pH.

Practical's:

1. Qualitative analysis of the carbohydrates.
2. Qualitative analysis of the protein by biuret method.
3. Qualitative analysis of the RNA by Orcinol method
4. Qualitative analysis of the DNA by Diphenylamine method
5. To estimate protein by using Lowry's method.
6. Determination of saponification value of oil or fat.
7. To isolate potato starch.
8. To isolate cholesterol and lectin from egg yolk.
9. Qualitative analysis of starch.
10. To Perform the Sudan IV Test for Lipids.
11. Identifying solutes and determining their concentration (spectrophotometer)
12. Solubility of lipid in polar and non-polar solvent
13. Separation of amino acids by paper chromatography.
14. Acid base titrations
15. To identify lipids in a given sample by TLC.
16. Mitosis: Cell Division
17. Meiosis
18. Study of structure of any Prokaryotic and Eukaryotic cell.
19 Isolation of chloroplast from cauliflower/ spinach.
20 To separate mixture of lipid by using thin layer chromatography.
21. Separate bromophenol blue and xylene by using agarose gel electrophosis
22. Separation of serum protein by agarose gel electrophosis

Reference

1. Biotechnology: A laboratory Skills Course, J. Kirk Brown 2011 (ISBN-13: 978-0-9832396-0-4)
2. Methods in Biotechnology, SB Hong, MB Rashid, LZ Santiago-Vazquez 2017 (ISBN-13: 978-1-119-15678-9)
3. Quantitative Analysis in Chemistry by Vogel (link is external)
4. Practical Chemistry for BSc I, II & III year students O.P Pandey, D.N Bajpai, S. Giri
5. Advanced practical physical chemistry by Yadav

First Year II Semester

Level		First Year (Semester II)																				
4.5	Course Type	Course code	Course Title	Type	Teaching period per week			Credit	Duration of Exam	Evaluation Scheme							Minimum Passing			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	TW	ESE	PR		CA/MSE/ TW	ESE	PR	
	Core	BBMML108	Biomolecules and Bioenergetics	Theory	2			2		10	10	10	-	20	-	50		8		20
	Core	BBMML109	Biology: Concept, Connections, Investigation and applications	Theory	3		-	3		20	20	20	-	40	-	100		16		40
	MIN	BBMIL110	Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	AEC		Communicative English II	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	OE**	BBOEL111	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	OE	BBOEL112	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	VSC*	BBVSP113	BT Lab II	Practical			4	2					30	20	50				8	20
	SEC*	BBSEP114	Explorations in Biotechnology –II	Practical			4	2					30	20	50				8	20
	Core	BBMMP115	Bio-Skills Lab Factory-I	Practical	-	-	2	1			-		30	-	20	50			8	20
	CC		Annexure I	Practical	-	-	4	2			-		30	-	20	50			8	20
	Total (L-T-P) Hrs / week = 29				**15**		**14**	**22**												

BBMML108 Biomolecules and Bioenergetics 2+0

University: MGM University, Aurangabad
Faculty: Basic and applied sciences
Institute: Institute of Biosciences and Tech.
Degree: B.Sc. (Hons/Hons. with research) Biotechnology **Course Unit Code:** BBMML108
Course Unit Title: Biomolecules and Bioenergetics **Credits allocated:** 2+0(Theory)
Level of Study: UG
Mode of delivery, planned learning activities and teaching method: Lecture 2hrs / weekly
Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

1. Develop in students the ability to apply the knowledge and skills they have acquired to thesolution of specific theoretical and applied problems in biochemistry.
2. Objectives of studying Biomolecules and Bioenergetics that is, to analyse, appreciate, understand the basic concepts of chemical reactions that occur in living systems, which enable them to understand the various perspectives of applied sciences that benefit the mankind.

Course outcomes:

1. Demonstrate knowledge and understanding of the molecular machinery of living cells; demonstrate knowledge and understanding of the principles that govern the structures of
2. macromolecules and their participation in molecular recognition; demonstrate knowledge and understanding of the principles and basic mechanisms of
3. metabolic control and molecular signalling; use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments

Detailed Syllabus:

Unit I: Biomolecules and Bioenergetics: (Lecture : 7)

The cellular basis of life. Major classes of biomolecules. Role of water in design of biomolecules. Thermodynamics –First law of thermodynamics, second law of thermodynamics, Gibbs free energy, endergonic & exergonic reactions. Standard state free energy changes-DG, DG0 and DG'0, Relationship between equilibrium constant and DG'o, Feasibility of reactions. ATP-Structure, properties and energy currency of the cell, Importance of Coupled reactions, High energy

compounds, Introduction to Metabolism - Catabolism, anabolism, catabolic, anabolic and amphibolic pathways.

Unit II: Amino acids, peptides, Sugars and polysaccharides (Lecture : 7)

Types of amino acids and their chemistry, derivatives of amino acids and their biological role. Introduction to biologically important peptides. Basic chemistry of sugars, optical activity. Disaccharides, trisaccharides and polysaccharides- their distribution and biologicalrole. Carbohydrate Metabolism:Glycolysis and its regulation, TCA cycle, amphibolic & amp; anaplerotic reactions. Electron Transport chain, Oxidative phosphorylation

Unit III: Nucleosides, nucleotides and nucleic acids (Lecture : 8)

Structures and chemistry, DNA structures and their importance, different types of RNA. Unusual DNA structures, other functions of nucleotides.Amino Acid/ Nucleic Acid Metabolism: Biodegradation of amino acids – deamination,transamination, decarboxylation, urea cycle including its regulation. Biosynthesis of amino acids, Disorders of amino acid metabolism (phenylketonuria, alkaptonuria, Biologically active amines Recycling of Purineand Pyrimidine nucleotides by salvage pathways. Lesch-Nyhan syndrome

Unit IV: Lipids and Vitamins (Lecture : 8)

Various classes of lipids and their distribution, storage lipids, structural lipids in membranes, lipids as signals, Lipid Metabolism: Beta – oxidations of saturated & unsaturated fatty acids. Ketone bodies,production during starving and diabetes Biosynthesis of fatty acids Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate, energetics, Regulation of fatty acid biosynthesis.

Reference:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman Company, 2004.
2. Fundamentals of Biochemistry, Upgrade Edition, Wiley, 2002.
3. LubertStryer, Biochemistry, 4th Edition, W.H. Freeman

BBMML109 Biology: Concepts, Connections, Investigation and Applications 3+0

University: MGM University, Aurangabad Faculty: Basic and applied sciences

Institute: Institute of Biosciences and Tech.

Course Unit Code: BBMML109 **Credits allocated:** 3+0(Theory)

Degree: B.Sc. (Hons/Hons. with research). Biotechnology

Course Unit Title: Biology: Concepts, Connections, Investigation and Applications

Level of Study: UG

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

To familiarize students with the biology concept. structure of genetic material, organization of genes, genetic code and mechanisms involved in the expression of genetic material in final functional form.

Course outcome Students will acquire knowledge about biology concept

Detail Syllabus:

UNIT 1 Eukaryotic and prokaryotic cell (Lecture 11)

Eukaryotic and prokaryotic cell, organelle structure and functions, Integrated cellular functions, Apoptosis and natural cell death.

Brief account on plant and animal cells. Viruses – structure and features, types of viruses Building blocks of cell

CARBOHYDRATES- nomenclature, structure and functions, monosaccharides, disaccharides, polysaccharides, homo polysaccharides, hetero polysaccharides, Glycoproteins

LIPIDS- Classification and functions; Fatty Acids- even-odd, saturated and unsaturated, length, nomenclature, TAGs, Phospholipids, Steroids, lipoprotein, Cholesterol; Amphipathic lipids, Soaps and detergents.

UNIT 2 Nucleic Acid (Lecture 7)

NUCLEIC ACID- Nucleotides, structure and nomenclature, DNA structure, different forms of DNA, measurement units. Denaturation, Tm value, melting point and renaturation.

Structure of RNA and its types, role of different RNA, Ribozymes.

UNIT 3 PROTEINS- functions & its chemical nature (Lecture 9)

PROTEINS- functions chemical nature; Amino acid structure and properties, peptide bond, Levels of protein structure- primary, secondary (alpha helix and beta structures), tertiary and quaternary

structure. Other bonds in protein structure, examples. Properties of proteins and their Classification, Protein denaturation, Determination of protein structure, Isolation and purification of proteins.

UNIT 4 Enzymes (Lecture 9)

ENZYMES- Historical events in discovery, nomenclature and classification, properties, Enzyme activity, Factors affecting enzyme activity like concerntration of substrate or enzyme or product, temperature, pH, Active centre of enzymes, Enzyme inhibition, Coenzymes, Enzyme action.

UNIT 5 Techniques in RDT (Lecture 9)

TECHNIQUES in RDT- DNA isolation, RNA isolation, Protein isolation, gel electrophoresis,

Reference's; -

1. Biology: Concepts and Investigations, Mariëlle Hoefnagels , 2, illustrated
2. Biology: Concepts and Applications 10th Edition by Cecie Starr, Christine Evers, Lisa Starr
3. Biology: Concepts and Applications, Cecie Starr, Christine Evers, Lisa Star
4. Biology Concepts and Investigations, Mariëlle Hoefnagels: McGraw-Hill Europe
5. Campbell Biology: Concepts & Connections by Martha R. Taylor, Eric J. Simon, Jean L. Dickey, Kelly A. Hogan, Jane B. Reece
6. Biology by Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos , Susan Singe

BBMIL110 Microbial Physiology and Metabolism 2+0

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. Biotechnology **Degree:** B.Sc. (Hons/Hons. with research).

Course Unit Code: BBMIL110 **Course Unit Title:** Microbial Physiology and Metabolism

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

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

1. Microbial Physiology is an intensive course with the goal of integrating biochemistry and genetics to enhance the understanding of the microbial cell and the robust and diverse nature of life.
2. This fundamental paper discusses the importance of microorganisms
3. The course throws light on types of microorganisms in and around humans.

Course Outcomes:

By studying this syllabus students are able to:

1. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life
2. Microbial physiology and metabolism provides information on sources of energy and its utilization by microorganisms

Detail Syllabus

Unit I: Microbial Growth and Effect of Environment on Microbial Growth (Lecture 8)

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxicgrowth curve Microbial growth in response to environment –Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.

Unit II: Nutrient uptake and Transport (Lecture 8)

Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation.

Unit III: Chemo heterotrophic Metabolism – Aerobic Respiration (Lecture 7)

Concept of aerobic respiration. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, uncouplers and inhibitors

Unit IV: Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation (Lecture 7)

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation. Lactate fermentation (homofermentative and heterofermentative pathways). Introductionto phototrophic metabolism: an Overview - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria.

Suggested Reading:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley &Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India

   Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

4. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition.
5. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley&Sons
6. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley &Sons
7. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
8. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
9. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology.5thedition, McMillan Press.
10. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology.9thedition. McGraw Hill Higher Education

BBVSP113 **BT Lab - II** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. Biotechnology (UG) **Degree:** B.Sc. (Hons/Hons with research).

Course Unit Code: BBVSJ113 **Course Unit Title:** Micro Project

Credits allocated: 0+2(Practical's) **Level of Study:** UG

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

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

Course Objective:

1. The purpose of the mini-project is to allow you to explore the breadth of research that is being performed within the college.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Course 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.

- **Thrust Area**
  1. Molecular biology,
  2. Molecular breeding,
  3. Molecular diagnostics,
  4. Recombinant DNA technology,
  5. Plant tissue culture & genetic transformation,
  6. Genomics & proteomics,
  7. Bioinformatics
  8. Fermentation Technology

BBSEP114 **Explorations in Biotechnology-II** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied science

Institute: Institute of Biosciences and Tech. **Degree:**B.Sc (Hons/ Hons. With research) Biotechnology (UG)

Course Unit Code: BBSEP114 **Course Unit Title:** Explorations in Biotechnology -I

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

Total Hours:

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives

1. To unable students with different skills for preliminary needed skills for project designing and development
2. To aware student for understand market and their problem
3. To explore and aware the students for finding the solution on different problems

Course Outcomes

1. As an outcome of completing the course, students will able to
2. Explain the role bioscience scientist as a problem solver
3. Identify multi-disciplinary approach required in solving as biosciences problem
4. Build simple systems using biotechnology and bioinformatics
5. Analyses biosciences solutions from ethical perspectives
6. Analyses biosciences solution from sustainability perspectives
7. Use basics of science project management skills in doing projects
8. Demonstrate data acquisition and analysis skills using a tool

PRACTICALS-

1. To prepare the different culture media for growing micro-organisms to learn the methods for mainting bacteria.
2. Isolation of Azatobacter from soil.
3. To study minimal inhibitory concentration
4. Isolation of micro- organisms from water.
5. Isolation of micro- organisms from air.
6. Isolation of human micro flora.
7. To observe the epidermal cell from onion.
8. To observe the stomatal cell from leaves.
9. Preparation of blood smear and differential staining of blood cell.
10. Observation & germination of Pollen Grains by Hanging drop technique.
11. To study the growth curve.
12. Biochemical characterization of micro-organisms (IMVIC) test.
13. To study the susceptibility of a pathogen to range ofantibiotics.
14. Microbial examination of milk.
15. To extract alpha amylase from Bacillus Spp.
16. Biomass separation by centrifuge & filtration.
17. Extraction of caffeine from tea powder.
18. To study the HPLC.
19. To indentify lipid in given sample by thin layered chromatography.
20. Separation of amino acid using Paper Chromatography.
21. Extraction of protein from cereals.
22. To recover protein from solution by salting out & dialysis.
23. Separation & identification of protein by SDS PAGE.
24. To study mutation induced by uv light in bacteria.
25. To study the Photo repair or dark repair in bacteria
26. Isolation of plant cellular DNA

27. Quantitative analysis of DNA
28. Isolation of RNA from plant.
29. Isolation of genomic DNA.
30. To study PCR Technique.

BBMMP115 **Bio-skills Lab Factory-II** **0+1**

University: MGM University, Aurangabad **Faculty: Basic and applied sciences**

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc. Hons**.** Biotechnology (UG)

Course Unit Code: BBMMP115 **Course Unit Title:** Bio-skills Lab Factory

Credits allocated: 0+1(Practical) **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Practical 2Hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

To explore students with hands on laboratory techniques

To unable students for different skills sets

To acquire students Lab etiquettes

Applying principles of lab safety.

Keeping accurate records with sufficient information to reproduce what was done.

Preparing aqueous solutions of varying composition.

Applying core principles of cell and molecular biology.

Applying core principles of centrifugation and spectrophotometry.

Preparing microbiological media and applying aseptic technique in the culturing of microorganisms.

Oral and written communication, maintaining a professional work ethic, and working well with others.

Course Outcomes

1. Examine and apply the fundamentals of cellular and molecular biology concepts to biotechnology research and its practical applications.
2. Develop and maintain laboratory records according to standard scientific and industrial guidelines.

3. Employ mathematical skills and knowledge of chemistry to accurately prepare an aqueous solution with the desired chemical concentrations and ph.

PRCTICALS -

1) Visualization of chromosome in meiotic stage.
2) Isolation of mitochondria from cauliflower.
3) To study the lipid solubility of membrane.
4) Effect of detergent on erythrocyte membrane.
5) Study of osmosis in blood cell.
6) Isolation of casein from milk.
7) Simple staining of bacteria.
8) Negative staining of bacteria
9) Gram staining of bacteria
10) Bacterial cell wall staning.
11) Acid – fast staining of bacteria.
12) Capsule staining.
13) Estimation of protein by Lowery.
14) Estimation of protein by Biuret method.
15) Estimation of RNA by Orcinol method.
16) Estimation of amino acid by Ninhydrin method.
17) Enzyme activity of serum alkaline phosphatase.
18) Gel Electrophoresis.
19) Estimation of amount of DNA present in given unknown solution by Diphenylamine.
20) To study Antigen-Antibody .
21) Assay in ELISA(Enzyme link immunoassay)

Major
Biotechnology

List of Options to select from Bucket of Courses provided in various categories (Sample of Faculty of Basic and Applied Sciences):

Minor options Within Faculty of Basic Sciences	**Bioinformatics**
	Microbiology
	Food Microbiology
	Food Nutrition and Dietetics

Minor options from Other Faculty	**Faculty of Engineering and Technology**	**Faculty of Social Sciences and Humanities**	**Faculty of Design**	**Faculty of Management and Commerce**	**Interdisciplinary Faculty**	**Performing Arts**
	Artificial Intelligence (AI)	Journalism and Mass Communication	Product Design	Operations and Supply Management	Cosmetic Technology	Theatre Arts
	Machine Learning (ML)	Film Making	Visual Communication	Human Resource (HR)	Educational Technology	Dance
	Data Analytics	Photography	Contemporary Arts	Finance Management	Yog Sciences	Music
	Robotics	Psychology	Interior Design	Marketing	Physical Education	Painting
	Industrial Automation	Economics	Fashion Technology	Accounting	Library Sciences	Pottery

IKS (As per the UGC guidelines. Visit Link:https://iksindia.org/English-BGSamposhan-Kendram-1-updated.pdf) * **	**Faculty of**		**AEC (to be discussed and developed by committee of Dean)***			**OE (Provide 4-8 courses of your department to be approved by the BOS)**	**Faculty of**
Holistic medicine and wellness			Communicative English			Biotechnology and Human Welfare	Biotechnology
Indian psychology and yoga			Communication and Soft Skills			Chemistry for biology	
Indian sports and martial arts			German			Quality Control In Food And Pharmaceutical Industries	Biotechnology
Architectural engineering, town planning, civil engineering, Vaastu and Shilpa Shastra			French			Sustainable agriculture with Biotechnology	Biotechnology
Sustainable agriculture and food preservation methods			Spanish			Research Ethics	Life science

*****Courses For reference purpose only**

***Courses For reference purpose only**

VSEC (Respective departments will prepare the list)	**Faculty of**		**CC(Two courses to be finalized for I & II Semester)*** **		**VEC (to be discussed and developed by committee of Dean) *** **
			NSS	*****Courses For reference purpose only**	Universal Human Values
			Digital Awareness		
			Personality Development		Gandhian Studies
			Yoga		
			NCC		Value Education

Level			Second Year (Semester III)																								
					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks									Minimum Passing (Marks)								
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal				External		Total					
										CA1	MSE	CA2	TW	ESE	PR		CA/MSE/TW				ESE	PR						
5.0	Core	BBMML201	Genome maintenance and regulation	Theory	2	-	-	2		10	10	10	-	20	-	50					8		20					
	Core	BBMML202	Fermentation Technology	Theory	3	-	-	3		20	20	20	-	40	-	100					16		40					
	Core	BBMML203	Principles of Developmental Biology	Theory	2	-	-	2		10	10	10	-	20	-	50					8		20					
	OE	BBOEL204	Annexture I	Theory	2	-	-	2		10	10	10	-	20	-	50					8		20					
	MIN	BBMIL205	Annexture I	Theory	2	-	-	3		20	20	10	-	40	-	100					16		40					
	AEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50					8		20					
	MIN	BBMIL206	Annexture I	Theory	-	-	2	1		10	10	10	-	20	-	50					8		20					
	VSC	BBVSJ207	Mini Project	Practical		-	4	2			-		30	-	20	50						8	20					
	Core	BBMMP208	Microbial Technology Lab.	Practical	-	-	2	1			-		30	-	20	50						8	20					
	FP	BBFPJ209	Filed Project	Practical		-	4	2					30	-	20	50						8	20					
	CC	-	Annexure I	Practical		-	4	2			-		30	-	20	50						8	20					
			Total =30		**14**		**16**	**22**																				

Level			Second Year (Semester IV)																					
					Teaching period per week			Credit	Duration of Exam	Evaluation Scheme (Marks						Total	Minimum Passing (Marks)						
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External			Internal				External		Total
										CA 1	MSE	CA2	TW	ESE	PR		CA	MSE	TW	ESE	PR	
5.0	Core	BBMML210	Molecular Immunology	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20
	Core	BBMML211	Gene Technologies	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	Core	BBMML212	Enzyme Engineering	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20
	OE	BBOEL213	Annexture I	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20
	MIN	BBMIL214	Annexture I	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	AEC		Annexture I	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20
	SEC	BBSEJ215	Mini Project	Practical		-	4	2					30		20	50					8	20
	MIN	BBMIL216	Annexture I	Practical	-	-	2	1		10	10	10	-	20	-	50				8		20
	Core	BBMMP217	Advances in Microbial Technology	Practical	-	-	2	1		-	-	-	30	-	20	50					8	20
	CEP	-	Community Engagement Program	Practical		-	4	2					30	-	20	50					8	20
	CC	-	Co-Curricular Course	Practical		-	4	2		-	-	-	30	-	20	50					8	20
			Total = 30		**14**		**16**	**22**														

Level 5.0Award of UG Diploma in major and minor with (44+44)= 88 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Level			Third Year (Semester V)																					
					Teaching period per week			Credit		Evaluation Scheme (Marks							Minimum Passing (Marks)							
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal			External			
									Duration of Exam	CA 1	MSE	CA2	TW	ESE	PR		CA	MSE	TW	ESE	PR	Total	
5.5	Core	BBMML301	Bioprocessing: Cell Culture & Scale up	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20	
	Core	BBMML302	System Biology	Theory	3		-	3		20	20	20	-	40	-	100				16		40	
	Core	BBMML303	Biomanufacturing process science & Experiment Designing	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20	
	Core elective	BBMEL304	Phyton	Theory	3		-	3		20	20	20	-	40	-	100				16		40	
	MIN	BBMIL305	Annexture I	Theory	3		-	3		20	20	20	-	40	-	100				16		40	
	VSC	BBVSP306	Environment Biotechnology	Practical		-	4	2					30		20	50					8	20	
	MIN	BBMIP307	Annexture I	Practical	-	-	2	1		10	10	10	-	20	-	50				8		20	
	VSC	BBVSP308	Mini Project	Practical	-	-	4	2		10	10	10	-	20	-	50				8		20	
	Core	BBMMP309	Introduction to Bio manufacturing Lab	Practical	-	-	2	1		-	-	-	30	-	20	50					8	20	
	FP/CEP	BBFPJ310	Field project community engagement	Practical		-	4	2					30	-	20	50					8	20	
	Core elective	BBMEP311	Phyton lab	Practical	-	-	2	1					30	-	20	50					8	20	
			Total =31		**13**		**18**	**22**															

Level			Third Year (Semester VI)																					
					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks							Minimum Passing (Marks)							
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal			External		Total
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW	ESE	PR	
5.5	Core	BBMML312	Synthetic Biology	Theory	2	-	-	2		10	10	10	-	20	-	50				8		20
	Core	BBMML313	RNA Technology	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	Core	BBMML314	Design Biomanufacturing, facilities, critical utilities, process & equipment	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	Core elective	BBMEP315	Genome Editing	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	MIN	BBMIL316	Annexture I	Theory	2		-	2		10	10	10	-	20	-	50				8		20
	MIN	BBMIL317	Annexture I	Theory	2	-		2		10	10	10	-	20	-	50				8		20
	OJT	BBJTI318	On Job Training	Practical		-	8	4					30		20	50					8	20
	Core	BBMMP319	Biological Lab.	Practical	-	-	2	1		-	-	-	30	-	20	50					8	20
	Core	BBMMP320	Mini Project	Practical	-	-	2	1		-	-	-	30	-	20	50					8	20
	Core elective	BBMEP321	Data analysis and statistics	Practical	-	-	2	1					30	-	20	50					8	20
			Total = 29		**15**		**14**	**22**														

Level 5.5 Award of UG degree in major and minor (44+44+44)=132 credits OR continue with major and minor

Level			Fourth Year (Semester VII)																					
					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks							Minimum Passing (Marks)							
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal			External		Total		
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW	ESE	PR			
6.0	Core	BBMML401	Exponential Biotechnologies-2 (Biosensors, 3D Bio-printing)	Theory	3		-	3		20	20	20	-	40	-	100				16		40		
	Core	BBMML402	Biotechnology Application (Biofertilizer, Biopesticide, Bioinsecticides and plant Tissue culture)	Theory	3		-	3		20	20	20	-	40	-	100				16		40		
	Core	BBMML403	Excitable cells: the foundation of neurosciences	Theory	3		-	3		20	20	20	-	40	-	100				16		40		
	Core	BBMML404	Introduction to Bioengineering	Theory	2		-	2		10	10	10	-	20	-	50				8		20		
	Core elective	BBMEL405	Introduction of R –programming	Theory	3		-	3		20	20	20	-	40	-	100				16		40		
	RM	-	Research methodology–I	Theory	3		-	3		20	20	20	-	40	-	100				16		40		
	RM	-	Research methodology–II	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20		
	Core elective	BBMEP406	R –programming lab	Practical	-	-	2	1					30	-	20	50					08	20		
	Core	BBMMP407	Bio industrial Lab.	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20		
	Core	BBMMP408	Excitable Lab.	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20		
	Core	BBMMJ409	Major Project	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20		
			Total = 27		**17**		**10**	**22**																

Level			Fourth Year (Semester VIII)																					
					Teaching period per week			Credits	Duration of Exam		Evaluation Scheme (Marks							Minimum Passing (Marks)						
	Course Type	Course code	Course Title	Type	L	T	P				Internal				External		Total	Internal			External		
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW	ESE	PR	Total
6.0	Core	BBMML410	Bioethics, Biosafety & IPR	Theory	3	-	-	3		20	20	20	-	40	-	100	-	-	-	16	-	40
	Core	BBMML411	Pharmaceutical Biotechnology	Theory	3	-	-	3		20	20	20	-	40	-	100	-	-	-	16	-	40
	Core	BBMML412	r-DNA technology	Theory	3	-	-	3		20	20	20	-	40	-	100	-	-	-	16	-	40
	Core	BBMML413	Genomics and proteomics	Theory	2	-	-	2		10	10	10	-	20	-	50	-	-	-	8	-	20
	Core elective	BBMEL414	Entrepreneurship and innovation	Theory	3	-	-	3		20	20	20	-	40	-	100	-	-	-	16	-	40
	OJT	BBJTP415	On Job Training	Practical	-	-	8	4		-	-	-	30	-	20	50	-	-	-	-	8	20
	Core elective	BBMEP416	Scale up Lab	Practical	-	-	2	1		-	-	-	30	-	20	50	-	-	-	-	8	20
	Core	BBMMP417	Genomics and proteomics lab	Practical	-	-	2	1		-	-	-	30	-	20	50	-	-	-	-	8	20
	Core	BBMMP418	RDT Lab	Practical	-	-	2	1		-	-	-	30	-	20	50	-	-	-	-	8	20
	Core	BBMMP419	Seminar (research paper based)	Practical	-	-	2	1		-	-	-	30	-	20	50	-	-	-	-	8	20
			Total = 30		**14**	-	**16**	**22**		-	-	-					-	-	-	-		

Level 6.0 Four year UG Honours Degree in major and minor (44+44+44+44) = 176 credits

Level			Fourth Year (Semester VII)																						
					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks							Minimum Passing (Marks)								
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal			External		Total			
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW	ESE	PR				
6.0	Core	BBMML401	Exponential Biotechnologies-2 (Biosensors, 3D Bio-printing)	Theory	3		-	3		20	20	20	-	40	-	100				16		40			
	Core	BBMML402	Biotechnology Application (Biofertilizer, Biopesticide, Bioinsecticides and plant Tissue culture)	Theory	2		-	2		20	20	20	-	40	-	100				16		40			
	Core	BBMML403	Excitable cells: the foundation of neurosciences	Theory	2		-	2		20	20	20	-	40	-	100				16		40			
	Core	BBMML404	Introduction to Bioengineering	Theory	2		-	2		10	10	10	-	20	-	50				8		20			
	Core elective	BBMEL405	Introduction of R – programming	Theory	3		-	3		20	20	20	-	40	-	100				16		40			
	RM	-	Research Methodology	Theory	3		-	3		20	20	20	-	40	-	100				16		40			
	RM	-	Research Methodology	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20			
	Core elective	BBMEP406	Bio industrial Lab.	Practical	-	-	2	1					30	-	20	50					08	20			
	Core	BBMMP407	Excitable Lab.	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20			
	RP	BBRPJ408	Research Project I	Practical	-	-	8	4		-	-	-	30	-	20	50					08	20			
			Total = 29		**15**		**14**	**22**																	

Level			Fourth Year (Semester VIII)																						
6.0					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks							Total	Minimum Passing (Marks)						
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal			External		Total
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW	ESE	PR	
	Core	BBMML409	Bioethics, Biosafety & IPR	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	Core	BBMML410	Pharmaceutical BiotechnologY	Theory	2		-	2		20	20	20	-	40	-	100				16		40
	Core	BBMML411	Recombinant DNA technology	Theory	2		-	2		20	20	20	-	40	-	100				16		40
	Core	BBMML412	Enterprenurship and innovation	Theory	2		-	2		10	10	10	-	20	-	50				8		20
	Core elective	BBMEL413	Genomics and proteomics	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	Core elective	BBMEP414	Pharma &genomic lab	Practical	-	-	2	1					30	-	20	50					08	20
	Core	BBMMP415	RDT lab	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20
	RP	BBRPJ416	Research Project II	Practical	-	-	16	8		-	-	-	30	-	20	50					08	20
			Total = 32		**12**		**20**	**22**															

Level 6.0Four year UG Honours with research Degree in major and minor (44+44+44+44) = 176 credits

*[Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year.]

BBOEL103 Biotechnology for human welfare 2+0

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc. (Hons/Hons. with research)Biotechnology

Course Unit Code: BBOEL103 **Course Unit Title:** Biotechnology for Human Welfare

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

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives:

1.To make students aware of Biotechnology

2.To introduce different areas in Biotechnology

3.To introduce students with the role of Biotechnology in Human welfare

Course Outcomes:

Students should be able to understand

1.What is biotechnology?

2.About the biotechnology institute in India

3.Different areas in biotechnology

4.Role of Biotechnology in Human welfare

Detail Syllabus

Unit – 1: Introduction to Biotechnology (7 lectures)

Introduction, Milestones in the History of Biotechnology, Traditional and Modern Biotechnology, Areas of Biotechnology (Red, Green, White, Blue), commercial potential of biotechnology, Biotechnology in India, Renounced Biotechnology institutes in India (IIT,

IISER, NCL, NCCS, ARI, NIV, CCMB, CDFD etc.) Agencies in India : DBT, DDFSL, DFS, FSL, RFSL, MFSL, CFSL, GEQD, NFB, NCRB, CID, CBI, IB, RAW, NIA etc

Unit – 2: Food Product (7 lectures)

Enzymes for textile industry, breweries, food supplements – single cell protein, vitamins, food processing - cheese, yoghurt making, biodegradable plastics, biofuels.

Unit – 3: Environment (8 lectures)

Applications of Biotechnology in environmental aspects: waste management, biodegradation of heavy metals, water cleaning, removing oil spills, air and soil pollution, bioremediation, biomining. degradation of hydrocarbons and agricultural wastes,

Unit – 4: Human Health and livestock (8 lectures)

Applications in Human Health: Antibiotic production, Molecular diagnostics, vaccines and vaccine delivery, recombinant therapeutics – insulin, gene therapy, forensics.

Applications in livestock improvement: transgenic animals, animal vaccine production, Increased milk production, artificial insemination, poultry and fisheries.

Text Books/References

1.Bhasin, M.K. and Nath, S. 2002. Role of Forensic Science in the New Millennium, University of Delhi,

2.Crueger Wand Crueger, A. 2000. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

3.Hans-Joachim Jordening and Jesef Winter, 2005Environmental Biotechnology Concepts and Applications.

4.Nanda, B.B. and Tiwari, R.K. 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi

5.Patel, A.H. 1996. Industrial Microbiology.1st edition, Macmillan India Limited.

6.Pradipta Kumar Mohapatra, 2020. Environmental Biotechnology, Dreamtech Press.

7.Stanbury, P.F., Whitaker, A. and Hall, S.J. 2006. Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

BBOEL104 CHEMISTRY FOR BIOLOGY 2+0

University: MGM University, Aurangabad Faculty: Basic and applied sciences

Institute: Institute of Biosciences and Tech. Degree :B.Sc. (Hons/Hons. with research)Biotechnology

Course Unit Code: BBOEL104 **Course Unit Title :**Chemistry for Biology

Credits allocated: 2 **Level of Study :** UG

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

Recommended Year /Semester: B.Sc Biotechnology , Year 1/ Semester I

Course Objective

Chemical reactions and strategies to balance them. the relative quantities of reactants and products. the fundamental properties of atoms, molecules, and the various states of matter.

Course outcome

Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.

Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health, and medicine.

Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

Students will be able to function as a member of an interdisciplinary problem-solving team.

Detail Syllabus

THEORY (30 lectures)

Unit-1 -Structure of Atom & Chemical Bonding (7 lectures)

Atom - Concept, Subatomic particles, Rutherford’s nuclear atomic model, Bohr’s atomic model its postulates and limitations, atomic orbitals, Hybridization and its type Planks quantum theory, quantum numbers, Heisenberg’s uncertainty principle, Hund’s rule. Chemical bond and its type, Ionic bond, Covalent bond, Coordinate bond and Hydrogen

Bond and its characteristics, Valance bond theory (VBT), Molecular orbital theory (MOT) structure of Homonuclear diatomic molecules (H2, N2,O2, F2) Valance shell electron pair repulsion theory (VSEPR) , Shapes of BeCl2, BF3, CH4, NH3 and H2O.

Unit-2 Chemical kinetics and Energetic (7 lectures)

Homogeneous, Heterogeneous, Reversible, Irreversible reactions, Rate of reaction, Collision theory of reaction rate, Rate equation / Rate law, Factors affecting rate of reaction.

Thermochemical reactions-Exothermic & Endothermic reaction, Enthalpy of reaction and its type, Enthalpy of formation, Enthalpy of combustion, Enthalpy of Neutralization, Hess's law of constant heat summation.

Unit-3 Alkanes, Alkenes, Alkynes. (8 lectures)

Alkane: Concept, Structure, Nomenclature, Preparations of alkane, Physical and chemical properties of alkanes. Octane number.

Alkenes: Concept, Structure, Nomenclature, Methods of preparation of alkenes, Physical properties of alkenes, chemical properties of alkenes (Hydrogenation, Halogenation, Hydrohalogenation, (Markovnikov's rule and peroxide effect), Hydration, Oxidation and Polymerization of alkenes.

Alkyl halide and its derivatives:Alkynes: Concept, Nomenclature, Methods of preparation, Physical and chemical properties Alkynes Concept of alkyl halide, structure, Nomenclature, Methods of preparation of Alkyl halide, Physical and Chemical properties, Substitution reaction (SN1 & SN2), Elimination reaction (E1 & E2) Hoffmann Rule.

Unit-4 Stereochemistry in Organic compounds (8 lectures)

Concept of isomerism, Classification of isomerism (structural isomerism & Stereo isomerism), Optical isomerism, Optical activity, Elements of symmetry, Chiral molecule, Projection formulae, Enantiomers, Diastereomers, Meso compounds and there properties.

Heterocyclic Compounds Concept and classification, 5-Membered Heterocyclic compounds Pyrrole: Structure, methods of preparation, physical and chemical properties, Furan: Structure, methods of preparation, physical and chemical properties, Thiophen: Structure, methods of preparation, physical and chemical properties.

Text books to refer:

1.Chemical Bonds: An Introduction to Atomic and Molecular Structure by Harry B. Gray.
2.A text book of Organic chemistry – B.S.Bahl & Arun Bahl
3.Text book of Essentials of Physical chemistry – B.S.Bahl, Arun Bahl & G.D.Tuli

4.Organic Chemistry Objective by Arihant (for practicing problems)

5.Wiley's solomons, fryhle & snyder organic chemistry by M.S Chouhan.

6Textbook of Organic Chemistry by P.S kalsi.

Reference:

1.Advanced Physical chemistry – Puri & Sharma

2.Concise Inorganic Chemistry-J.D. Lee

3.Organic Chemistry (Second Edition) by Clayden, Nick Greeves, and Stuart Warren.

4.Advanced Organic Chemistry. Francis A. Carey, Richard A. Sundberg

5.Reactions, Rearrangements and Reagents – S, N Sanyal

6.Stereochemistry of organic compounds- P S Kalsi

BBOEL111 Quality Control In Food And Pharmaceutical Industries 2+0

University: MGM University, Chh Sambhajinagar **Faculty:** Basic and applied sciences

Institute: Institute of Bioscience and technology. **Degree:** B.Sc. (Hons/Hons. with research) Biotechnology

Course unit code: BBOEL111 **Course:** Quality Control In Food And Pharmaceutical Industries

Credits allotted: (2+0) **Level of Degree:** UG

Mode of delivery, planned learning activities and teaching method: Recommended Year I /Semester: II

Unit 1 Microbiological Laboratory and Safe Practices (07 Periods)

Good laboratory practices - Good laboratory practices, Good microbiological practices; Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

Unit 2 Determining Microbes in Food / Pharmaceutical Samples (07 Periods)

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products; Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water (07 Periods)

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Food Safety and Microbial Standards (07 Periods)

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

References:

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press

2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

BBOEL112 Sustainable agriculture with Biotechnology 2+0

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc. (Hons/Hons. with research) Biotechnology

Course Unit Code: BBOEL112 **Course Unit Title:** Sustainable agriculture with Biotechnology

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

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

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objective :

The course will provide an understanding of plant biotechnology topics such as applications of plant tissue culture, bio fertilizers, bio pesticides, genetic engineering and molecular markers. Other biotechnology topics such as GM Crop ,Biofuels and bio manure would be covered.

Course Outcome :

Students will be able to use the scientific method to complete an extensive laboratory experiment that is designed to evaluate potential feed source varieties for sustainable success within their local community.

Detail Syllabus

Unit 1 Soil Microbiology (07 Lectures)

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

Unit 2 Microbial Activity in Soil , Green House Gases and Soil Borne Plant Pathogens (07 Lectures)

Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control. Microbial Control of Soil Borne Plant Pathogens: Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds

Unit 3 Bio fertilization, Phytostimulation, Bio insecticides (08 Lectures)

Plant growth promoting bacteria, bio fertilizers – symbiotic (Brady rhizobium, Rhizobium,

Frankia), Non Symbiotic (Azospirillum, Azotobacter, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs

Unit 4 Secondary Agriculture Biotechnology and GM crops (08 Lectures)

Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters; GM crops: Advantages, social and environmental aspects, Bt crops, golden rice

References:

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, I st edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG