ST JOSEPH'S UNIVERSITY

BENGALURU-27

DEPARTMENT OF MICROBIOLOGY

SYLLABUS FOR UNDERGRADUATE PROGRAMME

For Batch 2024-2027

(STATE EDUCATION POLICY)

Part A		
1	Title of the Academic Program	B.Sc. Microbiology (Major)
2	Program Code	**BCYM (Biochemistry, Biology, Microbiology), BCMZ (Biochemistry, Microbiology, Zoology), CMBY (Chemistry, Microbiology, Biology)**
3	Name of the University	St. Joseph's University
4	Objectives of the University	1. Academic Excellence 2. Character Formation 3. Social Concern
5	Vision of the University	To form men and women for and with others, who through holistic education, strive for a just, secular, democratic, and ecologically sensitive society which empowers the poor, the oppressed, and the marginalized.
6	Mission of the University	In keeping with the Jesuit heritage, the university aims at an integral formation of the staff and the students, to be men and women who will be agents of societal change, by enabling them to attain academic and human excellence in a teaching-learning environment that fosters intellectual curiosity, ceaseless enquiry, personal integrity, social commitment, creativity, critical thinking and innovation.
7	Name of the Degree	Bachelor of Science (B.Sc.)
8	Name of the Department offering the program	Microbiology
9	Vision of the Department offering the program	• The Department intends to inculcate in the students an interest to explore the world of Microbiology and contribute to the rapidly expanding field. We wish to offer the society, a generation of humble yet aspiring young minds eagerly striving towards unraveling the mystery of science.
10	Mission of the department offering the Program	• The Department of Microbiology aims at identifying one's potential to become a centre for augmenting and contributing continuously to the vibrant field of Microbiology. • We strive to create and provide an ambient learning atmosphere and prepare students for academia, industry and productive application of this knowledge in everyday life. • It emphasizes the impact of microbes on environment and the human activities.
11	Duration of the Program	3 years (Six semesters)
12	Total No. of	TO BE ANNOUNCED

	Credits		
16	Program Specific Outcomes (PSOs)	PSO1	Students graduating from the Microbiology program will gain knowledge and understanding of concepts of microbiology and its application in pharma, food, agriculture, beverages, nutraceutical industries, etc.
		PSO2	Students will understand the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic culturing of microbes including isolation, identification and maintenance.
		PSO3	Students will be learning and practicing professional skills in handling microbes and contaminants in laboratories and production sectors, exploring the microbial world and analyzing the specific benefits and challenges.
		PSO4	Students will be able to apply the knowledge acquired to undertake studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors.
		PSO5	Students will also learn and build on proficiencies in science communication, teamwork and collaboration, enabled by regular innovative assignments and activities.
		PSO6	Students will be able to demonstrate the ability to identify key questions in microbiological research, optimize research methods, and analyze outcomes by adopting scientific methods, thereby improving the employability.

SUMMARY OF CREDITS IN MICROBIOLOGY

Semester 1	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Numb er of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	MB 124	Basic Microbiology and Microbiological Techniques	45	03	03	40	60	100
Practical	MB1P1 24	Basic Microbiology and Microbiological Techniques	33	03	02	25	25	50
Total Number of credits:			**05**					
Semester 2	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching Hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	MB 224	Microbial Diversity I	45	03	03	40	60	100
Practical	MB2P1 24	Microbial Diversity I	33	03	02	25	25	50
Total Number of credits:			**05**					
Semester 3	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Numb er of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	MB 325	Microbial Diversity II	45	03	03	40	60	100
Practical	MB3P1 25	Microbial Diversity II	33	03	02	25	25	50
Total Number of credits:			**05**					
Semester 4	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of teaching Hrs /week**	**Number of credits**	**Continuous Internal Assessment (CIA) Marks**	**End Semester Marks**	**Total marks**
Theory	MB 425	Microbial Enzymology and metabolism	45	03	03	40	60	100
Practical	MB4P1 25	Microbial Enzymology and metabolism	33	03	02	25	25	50
Total Number of credits:			**05**					

CORE COURSES (CC)	
Course Title	**Code Number**
Basic Microbiology and Microbiological Techniques	MB 124
Microbial Diversity I	MB 224
Microbial Diversity II	MB 325
Microbial Enzymology and metabolism	MB 425

VALUE ADDED COURSES (VAC)	
Course Title	**Code Number**
Principles of Genetic Engineering	MBCC 01
Food Technology	MBCC 02
Ethics in Life Sciences and Health care Sector	MBCC 03

DEPARTMENT OF MICROBIOLOGY

Semester	I
Course	1
Paper Code	**MB 124**
Paper Title	**Basic Microbiology and Microbiological Techniques**
Number of teaching hours per week	03
Total number of teaching hours per semester	45
Number of credits	03

Objective of the Paper:
This paper introduces the students to the microbial world. It emphasizes on the contribution of scientists to the evolution of the field of Microbiology as an essential modern science. The students will have an in-depth understanding of the prokaryotic and eukaryotic cellular forms, using bacteria and protozoans as model organisms. The students will get equipped with microscopic, staining and sterilization techniques.

UNIT-I **Historical Perspective**	**4**
a. History and Scope of Microbiology: Relevance of Microbiology as a modern science Branches of Microbiology Scope of Microbiology and career opportunities in the field. **b. Contribution of Scientists to the field of Microbiology**: Antonie Von Leeuwenhoek, Francisco Redi, Edward Jenner, Louis Pasteur, Joseph Lister, Robert Koch and Alexander Fleming.	**2** **2**
UNIT- II **Introduction to the Microbial World**	**5**
Structure and Overview of Different Groups of Microbes (Brief overview of morphology and importance) **a. Bacteria** **b. Fungi** **c. Algae** **d. Protozoa** **e. Virus**	

UNIT-III **Introduction to prokaryotic microorganisms**	**10**
Bacteriology: **a. Ultrastructure of a bacterial cell:** detailed study of- flagella, pili and capsule, cell wall (gram positive and gram negative), cell membrane, mesosomes, ribosomes, and genetic material. Inclusion bodies and reserve food materials. **b.** Endospore – structure, function, sporulation and germination. **c.** Reproduction in bacteria: binary fission **d. Bacteria with unusual properties:** (Ultrastructure and functions) Mycoplasma Actinomycetes Rickettsia	**8** **2**
UNIT-IV **Introduction to eukaryotic microorganisms**	**5**
a. Cellular organization of eukaryotes- General structure and intracellular organelles- cell membrane, cytoskeleton, Membrane-bound organelles- Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles, Nucleus, Mitochondrion, Chloroplast, Peroxisomes, and Ribosomes. **b. Protozoology:** General characters of protozoans. E.g.- Paramecium.	**3** **2**
UNIT-V **Microbiological Techniques- Visualization of Microbes**	**11**
a. **Microscopy** Introduction to Concepts of Light- Reflection, Refraction, Diffraction, Interference, and Fluorescence. Light Microscopy-Bright field, Dark field, Fluorescence, Confocal Microscopy and Phase contrast Microscopy Electron microscopy -TEM and SEM b. **Staining Techniques:** Composition of stain and types Simple staining (Negative staining), Differential staining (Gram's staining), Structural staining (Endospore staining)	**8** **3**

UNIT VI Microbiological Techniques- Sterilization of Microbes	10
Concept of sterilization and disinfection and its importance in Microbiology. **i) Factors affecting antimicrobial activity**: - Environment, organisms, physiological status, inoculum concentration, intensity of concentration of the antimicrobial agent, temperature, and time of action as factors affecting antimicrobial activity. **ii) Physical methods of sterilization:** Moist heat (Pasteurization) Moist heat under pressure (Autoclave) Dry heat (incineration, hot air oven) Filtration- membrane filter, HEPA filter Radiation (UV- rays, X- rays, Gamma rays, ultrasonic rays) **iii) Chemical agents used in sterilization:** Desired characteristics and mode of action of antimicrobial chemical agents**.** Alcohols, formaldehyde, phenol, halogens and heavy metals, and gaseous agents. **Efficacy testing of chemical agents**- Phenol coefficient test	**2** **4** **4**

NOTE: 10 hours of self-study (study materials and videos will be provided)

REFERENCES:

1	Black, J. G., & Black, L. J. (2008). *Microbiology: Principles and explorations*. Hoboken, NJ: John Wiley & Sons, Inc.
2	Madigan, M. T. (2017). *Brock Biology Of microorganisms*.
3	Murphy, D. B., & Davidson, M. W. (2012). *Fundamentals of Light microscopy and Electronic Imaging.* John Wiley & Sons.
4	O.P. Sharma. (1992), *Textbook of Algae*, New Delhi: Tata McGraw-Hill.
5	Talaro, K. P. (2008*). Foundations in Microbiology: Basic principles*, New York: McGraw-Hill, 11th Edition.
6	Willey, J. M., Sherwood, L., & Woolverton, C. J. (2017). *Prescott's Microbiology.*

BLUEPRINT:

Code number: MB 124
Title of the Paper: Basic Microbiology and Microbiological Techniques

Unit number	Number of Hrs	Total marks for which the questions are to be asked (including bonus questions)
Unit I	4	8
Unit II	5	10
Unit III	10	20
Unit IV	5	10
Unit V	11	22
Unit VI	10	20
	45	88
Maximum marks for the paper (Excluding bonus question) = 60		

Practical I

MB 1P1 24 - Basic Microbiology and Microbiological Techniques

(11 sessions 3hr/week)

Sr. No.	Experiment	Units
1	Microbiological laboratory standards and safety protocols.	1
2	Standard aseptic conditions of Microbiological laboratory.	
3	Study of a compound microscope.	1
4	Study of instruments - Autoclave, hot air oven, LAF and biosafety cabinets, incubator, membrane filter, colony counter. Applications of basic microbiological tools (Pipettes, Micropipette, Bunsen burner, Inoculation loop, Spreader).	
5	Preparation of media – NB, NA.	1
6	Isolation and identification of bacteria- Cultural characteristics and CFU calculation,	1
7	Pure culture techniques – pour plate, spread plate and streak plate (Simple, Continuous, Quadrant) methods.	1
8	Aseptic transfer techniques.	
9	Simple staining, Negative staining	1
10	Differential staining- Gram's staining	1
11	Structural staining- Endospore.	2
12	Bacterial motility- hanging drop.	1

Course outcomes for MB 124 and MB1P1 24

At the end of the course, the student will be able to:

CO1	Appreciate the contributions of Pioneers in the field of microbial research.
CO2	Get acquainted with different types of microbial life forms and their basic structure and functions.
CO3	Understand the basics of the structural organization of a prokaryotic and eukaryotic cell.
CO4	Apply the knowledge gained to identify and use various laboratory aids to culture, visualize and control microorganisms.
CO5	Assess the importance of microbes in all realms of life.
CO6	Apply the basic disinfection and sterilization techniques to maintain health and hygiene.

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Semester	II
Course	2
Paper Code	**MB 224**
Paper Title	**Microbial Diversity - I**
Number of teaching hours per week	03
Total number of teaching hours per semester	45
Number of credits	03

Objective of the Paper:
This paper allows students to understand microbial systematics and methods to classify some of the microbes. It helps them explore the different types of microorganisms, their growth patterns, preservation techniques, and control methods.

UNIT I **Microbial Taxonomy**	**10**
a. **Microbial Systematics -** 5 kingdom classification system, 3 domain classification system Concept of 'species' in eukaryotes and prokaryotes, Nomenclature Phenetic classification, Phylogenetic classification, Genotypic classification b. **Classification** on the basis of Classical characters and Molecular characters- Numerical taxonomy, chemotaxonomy and genetic analyses c. **Phylogenetic trees** – rooted and unrooted d. **Classification based on pathogenicity.** Biosafety level 1, 2, 3, and 4.	5 4 1
UNIT II **Bacteriology – Growth and control**	**20**
Bacterial classification - Bergey's Manual of Bacteriology **Growth and maintenance of bacteria** – a. Nutritional requirements and types b. Types of Media for microbial growth- Differential and selective media, enrichment media, transfer media, defined and undefined media c. Bacterial growth curve and calculation of generation time. Diauxic growth curve. Technique for determination of microbial growth - Spectrophotometry	2 10

d. Long term maintenance of microorganisms- glycerol stocks, cryopreservation, lyophilization **Control of bacterial growth -** a. Development and classification of antibiotics. b. Mode of action and types– Antibacterial antibiotics: Cell wall synthesis inhibitors – Penicillin, Protein synthesis inhibitors- Tetracyclines and Chloramphenicol, DNA synthesis inhibitors- Fluoroquinolones, RNA synthesis inhibitors- Rifampin, mycolic acid synthesis inhibitors- isoniazid, membrane disruptors- Polymyxin B c. Development of Resistance to antibiotics, mechanisms of resistance and determination of antibiotic resistance.	8
UNIT III **Virology**	**15**
Viral Classification – Baltimore **Structure, Reproduction and Significance of -** Bacterial viruses - T4, Plant virus- TMV, Animal virus – HIV **Cultivation of viruses, one step growth curve and plaque assay** **Antiviral therapies** – concepts of antiviral therapies Phage therapy	1 7 4 2 1

NOTE: 10 hours of self-study (study materials and videos will be provided).

REFERENCES:

1.	Black, J. G., & Black, L. J. (2008). *Microbiology: Principles and explorations*. Hoboken, NJ: John Wiley & Sons, Inc.
2.	Madigan, M. T. (2017). *Brock Biology Of microorganisms.*
3.	Primrose, S. B. (1974). *Introduction to modern virology*.
4.	Wilson, K. and Walker, J. (2010) *Principles and Techniques of Biochemistry and Molecular Biology*. Cambridge University Press, Cambridge.
5.	Willey, J. M., Sherwood, L., & Woolverton, C. J. (2017). *Prescott's Microbiology*.

BLUEPRINT:

Code number: MB 224
Title of the Paper: Microbial Diversity - I

Unit number	Number of Hrs	Total marks for which the questions are to be asked (including bonus questions)
Unit I	10	20
Unit II	20	39
Unit III	15	29
	45	88
Maximum marks for the paper (Excluding bonus question) = 60		

Practical II

MB2P1 24 – Microbial Diversity - I

(11 sessions 3hr/week)

Sr. No.	Experiments	Units
1.	Bacterial growth on different types of media- NA, minimal agar, EMB, Mc Conkey agar	2
2.	Bacterial growth curve	1
3.	Growth of bacteria on various Carbon and Nitrogen sources	2
4.	Biochemical tests for the identification of bacteria- IMViC, starch hydrolysis, TSI, Gelatin liquefaction, catalase and oxidase test, Carbohydrate fermentation.	2
5.	Preparation of glycerol stocks	1
6.	Bacteriophage Plaque assay	2
7.	Antibiotic assay – Kirby Baur's	1

Course outcomes for MB 224 and MB2P1 24
At the end of the course, the student will be able to:

CO1	Demonstrate knowledge of microbial systematics, including the 5-kingdom classification system and the 3-domain classification system, and explain their significance in understanding microbial diversity.
CO2	Develop an understanding of nutritional requirements of various microorganisms for their subsequent growth/cultivation and control.
CO3	Perform basic experiments to culture, identify, classify and preserve microorganisms in the laboratory.
CO4	Carry out comparative analysis of growth requirements of various kinds of microorganisms.

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Semester	III
Course	1
Paper Code	**MB 325**
Paper Title	**Microbial Diversity - II**
Number of teaching hours per week	03
Total number of teaching hours per semester	45
Number of credits	03

Objective of the Paper:
This paper allows the student to understand the nuances of the microbial world, emphasizing the significance of algae and fungi. The paper gives insight into the various interactions microbes undergo to sustain themselves in an environment. The microbial ecological implications are a fundamental way to understand the role microbes play in the environmental balance.

UNIT- I **PHYCOLOGY**	**13**
a. Cyanobacteria- Ultrastructure and reproduction. b. Economic importance of cyanobacteria. c. Algae - Occurrence, General characteristics, ultrastructure, pigments, flagella, eyespot food reserves, and reproduction of algae. d. Reproduction in Algae: i) Vegetative - fragmentation, fission, tubers, budding, hormogonia. ii) Asexual - Spore production. iii) Sexual - Isogamy, Anisogamy and Oogamy. iv) Overview of Life Cycles in Algae: Haplontic, Diplontic, Diplohaplontic, Haplobiontic, Diplobiontic. e. Economic importance of algae.	2 1 3 6 1
UNIT-II **MYCOLOGY**	**14**
a. General Characteristics and morphology of Fungal cell - Yeast and Hyphal structure. b. Ultrastructure of fungal cell-Thallus organization, cell wall, cell membrane, and	2

flagella. c. Growth and cultivation of fungi. d. Reproduction in fungi- sexual, asexual, and parasexual. e. Concepts of nomenclature and classification, fungal biodiversity. f. Study of fungal classes (Alexopolus & Mims,1979) Zygomycetes (*Mucor*), Ascomycetes (*Saccharomyces)*, Basidiomycetes (*Agaricus*) and Deuteromycetes (*Alternaria*). g. Economic importance of fungi.	2 2 2 1 4 1
UNIT-III **EFFECT OF ENVIRONMENT ON MICROBES**	**5**
a. Effect of environmental factors on the growth of microorganisms - Temperature, pH, oxygen, pressure, solute, and water activity. b. Oligotrophic environments.	4 1
UNIT-IV **MICROBIAL INTERACTIONS**	**13**
a. Concept of symbiosis, symbiotic interactions - Mutualism (microbe-microbe mutualism), Cooperation, Commensalism, Parasitism, Predation, Amensalism, Competition. b. Biofilm - formation; its clinical and economic implications. c. Human-microbe interactions - normal microbiota of the human body (with special emphasis on the development of gut microbiota).	8 2 3

NOTE: 10 hours of self-study (video content and study material) will be provided.

REFERENCES:

1.	Willey, J. M., Sherwood, L., & Woolverton, C. J. (2017). Prescott's Microbiology.
2.	Black, J. G., & Black, L. J. (2008). Microbiology: Principles and explorations. Hoboken, NJ: John Wiley & Sons, Inc.
3.	Sharma, O. P. (1986). Textbook of Algae. Tata McGraw-Hill Education.
4.	Sharma, O. P. (2011). Fungi & allied microorganisms. Tata McGraw-Hill Education.
5.	Talaro, K. P. (2008). Foundations in Microbiology: Basic principles, New York: McGraw-Hill, 11th Edition.
6.	Staley, J. T. (2007). Microbial life. Sinauer Associates, Incorporated.
7.	Cole, L. A. (2016). Biology of life: Biochemistry, Physiology and Philosophy, Academic Press.

BLUE PRINT:

Code number: MB 325

Title of the Paper: Microbial Diversity - II

Unit Number	Number Of Hours	Total marks for which the questions are to be asked (including bonus questions)
UNIT I	13	25
UNIT II	14	27
UNIT III	5	11
UNIT IV	13	25
TOTAL	**45**	**88**
Maximum marks for the paper (Excluding bonus question) = 60		

Practical III

MB3P1 25– Microbial Diversity II

(11 sessions 3hr/week)

S. No.	Experiment	Units/sessions
1	Isolation and identification of bacteria and fungi.	2
2	Linear growth of fungi (pH 5-8)	2
3	Counting of yeast cells by hemocytometry.	1
4	Measurement of yeasts/ fungal spores by micrometry.	1
5	Observation of algae from environmental samples.	1
6	Effect of pH on growth of bacteria.	1
7	Effect of temperature on growth of bacteria.	1
8	Study of microbial interaction- Antagonism.	2

Course outcomes for MB 325 and MB3P1 25

At the end of the Course, the Student will be able to

CO1	Understand the algal and fungal diversity.
CO2	Gain an insight into the significance of environmental factors in microbial growth.
CO3	Understand microbial interactions and their implications to humankind.
CO4	Use the knowledge of microbes to produce economically important products.
CO5	Obtain a broader perspective on the significance of microbial populations in generating a sustainable living.

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Semester	IV
Course	1
Paper Code	**MB 425**
Paper title	**Microbial Enzymology and Metabolism**
Number of teaching hours per week	03
Total number of teaching hours per semester	45
Number of Credits	03

Objective of the Paper:
This paper enables a student to understand biomolecules and their role in various biochemical processes of microorganisms. It allows students investigate how specific enzymes catalyze biochemical reactions during aerobic and anaerobic respiration in different metabolic pathways of microorganisms. It also allows student to understand the structure, function, mechanisms, and regulation of enzymes to better elucidate their role in biochemical processes and apply this knowledge in fields like medicine, biotechnology, and industry

UNIT I **BIOMOLECULES**	**8**
a. Carbohydrates: Structure (mono, di and polysaccharides). **b. Amino acids and proteins:** Structure, classification and properties of amino acids and proteins. **c.** Overview of lipids and their importance	3 3 2
UNIT II **MICROBIAL ENZYMOLOGY**	**15**
a. Structure of enzyme, Apoenzyme, Holoenzymes, co-factors and co-enzymes. b. Classification and nomenclature of enzymes. c. Mechanism of action of enzymes: active site, transition state complex, activation energy, binding energy and allosteric site. d. Lock and key hypothesis and Induced Fit hypothesis. e. Significance of hyperbolic (Michaelis-Menten equation), double reciprocal plots (Lineweaver-Burk equation) of enzyme activity. f. Definitions of terms – enzyme unit, specific activity and turnover number.	2 1 2 1 3 2

g. Effect of pH and temperature on enzyme activity. h. Enzyme inhibition: competitive- sulfa drugs; non-competitive-heavy metal salts.	1 3
UNIT III **CHEMOHETEROTROPHIC METABOLISM - AEROBIC RESPIRATION**	**12**
a. Concept of aerobic respiration, anaerobic respiration and fermentation. b. Sugar degradation pathways: Glycolysis, Entner–Doudoroff pathway, Pentose phosphate pathway, Tricarboxylic acid cycle. Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, oxidative phosphorylation.	1 6 5
UNIT IV **CHEMOHETEROTROPHIC METABOLISM- ANAEROBIC RESPIRATION AND FERMENTATION**	**5**
a. Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration). b. Fermentation - Alcohol fermentation, Lactate fermentation (homofermentative and heterofermentative pathways) and mixed acid fermentation.	3 2
UNIT V **CHEMOLITHOTROPHIC AND PHOTOTROPHIC METABOLISM**	**5**
a. Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation and methanogenesis. b. Introduction to phototrophic metabolism - groups of phototrophic microorganisms, oxygenic vs. anoxygenic photosynthesis.	2 3

NOTE: 10 hours of self-study (study materials and videos) will be provided

REFERENCES:

1.	Atlas, R. M. (1995). *Principles of microbiology*. St. Louis: Mosby.
2.	David L Nelson, Michael M Cox (7th edition). *Lehninger Principles of Biochemistry*, Worth Publishers, Inc.
3.	Donald Voet, Judith Voet & Charlotte W. Pratt (4th edition). *Voet's Principles of Biochemistry*, John Wiley and Sons.
4.	Gottschalk G. (1986). *Bacterial Metabolism*. 2nd edition. Springer Verlag.
5.	J. L. Jain, Sunjay Jain and Nitin Jain (2007). *Fundamentals of Biochemistry*. S. Chand & Company Ltd.
6.	Madigan MT, and Martinko JM (2014). *Brock Biology of Microorganisms*. 14th edition.

	Prentice Hall International Inc.
7.	Moat AG and Foster JW. (2002). *Microbial Physiology*. 4th edition. John Wiley & Sons.
8.	Mary K. Campbell and Shawn O. Farrell (8th edition). *Biochemistry*, Cengage Learning.
9.	Garrett, R. H., and Grisham, C. M. *Biochemistry*. 2nd edition. Saunders College Publishing.
10.	Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). *General Microbiology*. 5th edition, McMillan Press.
11.	Willey JM, Sherwood LM, and Woolverton CJ. (2013). *Prescott's Microbiology*. 9th edition. McGraw Hill Higher Education.

BLUEPRINT:

Code number: MB 425

Title of the Paper: Microbial Enzymology and Metabolism

Unit number	Number of hours	Total marks for which the questions are to be asked (including bonus questions)
UNIT I	6	12
UNIT II	15	29
UNIT III	15	29
UNIT IV	5	10
UNIT V	4	8
	45	**88**
Maximum marks for the paper (Excluding bonus questions) = 60		

Practical IV

MB4P1 25: Microbial Enzymology and Metabolism

(11 sessions 3 hr/week)

S.No	Experiments	Units
1.	Buffer preparations for enzymatic activity and Numerical problems to explain the concepts.	1
2.	Estimation of proteins by Lowry's method.	1
3.	Isolation and Screening of amylase producing bacteria	1
4.	Production of microbial enzymes (amylase) and estimation of its activity.	1
5.	Study the effect of substrate concentration on enzyme kinetics (Km and Vmax).	2
6.	Study the effect of temperature on enzyme activity.	1
7.	Study the effect of pH on enzyme activity.	1
8.	Study the effect of heavy metals on enzyme activity.	1
9.	Carbohydrate fermentation test, MRVP, Triple Sugar Ion (TSI), Nitrate reduction.	2

Course outcomes for MB 425 and MB4P1 25

At the end of the course, the student will be able to:

CO1	Understand the properties of carbohydrates, amino acids, proteins and lipids.
CO2	Describe the multifarious function of enzymes; calculate enzyme activity and other quantitative and qualitative parameters of enzyme kinetics.
CO3	Understand the differentiating concepts of aerobic and anaerobic respiration.
CO4	Summarize the different metabolic pathways in microorganisms.
CO5	Critique the role of enzymes, coenzymes, and cofactors involved in different pathways.