

B.Sc.MICROBIOLOGY (HPP)

OVERALL COURSE STRUCTURE (Principal Subject Only)

Semester – I

Course Code	Course Title	Theory	Tutorial	Practical	Contact hours	Credits	Category
MBY1101PT	Foundations of Microbiology	3	-	-	3	3	Core-1
MBY1102PT	Structural components and building blocks of cells	2	-	-	3	2	Core-2
MBY1103PL:	Practicals	-	-	3	6	3	P1
	Semester	5	0	3	12	8	

Semester – II

Course Code	Course Title	Theory	Tutorial	Practical	Contact hours	Credits	Category
MBY1201PT	Fundamentals of Bacteriology	3	-	-	3	3	Core-3
MBY1202PT	Basic Biochemistry	2	-	-	3	2	Core-4
MBY1203PL	Practicals	-	-	3	6	3	P2
	Semester	5	0	3	12	8	

Semester – III

Course Code	Course Title	Theory	Tutorial	Practical	Contact hours	Credits	Category
	Theory Paper	4	-	-	4	4	Core-5
	Theory Paper	4	-	-	4	4	Core-6
	Practicals	-	-	4	8	4	P3
	Semester	8	0	4	16	12	

Semester – IV

Course Code	Course Title	Theory	Tutorial	Practical	Contact hours	Credits	Category
	Theory Paper	4	-	-	4	4	Core-7
	Theory Paper	4	-	-	4	4	Core-8
	Practicals	-	-	4	8	4	P4
	Semester	8	0	4	16	12	

NOTE

- In FY BSc 30 students will take 8 Credits Chemistry and 8 Credits of Zoology and other 30 students 8 Credits Chemistry and 8 Credits of Botany as Core courses
- In SYBSc, the generic courses will be continued as per the FYBSc selection

Semester – V

Course Code	Course Title	Theory	Tutorial	Practical	Contact hours	Credits	Category
	Theory Paper	3	-	-	4	4	Core-9
	Theory Paper	3	-	-	4	4	Core-10
	Theory Paper	4			4	4	DSE -1
	Theory Paper	4			4	4	DSE-2
	Seminar	2			2	2	DSE-3
	Practicals	-	-	6	12	6	P5
	Semester	16	0	6	16	24	

Semester – VI

Course Code	Course Title	Theory	Tutorial	Practical	Contact hours	Credits	Category
	Theory Paper	3	-	-	4	4	Core-11
	Theory Paper	3	-	-	4	4	Core-12
	Theory Paper	4			4	4	DSE -4
	Theory Paper	4			4	4	DSE-5
	Seminar	2			2	2	DSE-6
	Practicals	-	-	6	12	6	P5
	Semester	16	0	6	16	24	

		The Maharaja Sayajirao University of Baroda Faculty of Science		ACADEMIC YEAR 20-21	
<u>B.SC. MICROBIOLOGY : HPP</u>					
YEAR	I	CORE MBY1101PT		CREDIT	3
Semester	I	FOUNDATIONS OF MICROBIOLOGY		HOURS	45
OBJECTIVES:		To introduce history and scope of Microbiology and provide a glimpse of the microbial world as well as methods to study them.			
COURSE CONTENT / SYLLABUS					
UNIT-I	History and scope of Microbiology				10 hrs.
	Discovery of the microbial world, contributions of early microbiologists in disproving the spontaneous theory of life, discovery of different physiological types of microbes, disease theory and vaccine development, discovery and applications of antibiotics, use of microorganisms for bioremediation, discovery and study of extremophiles, contributions of major pioneer scientists in golden ages of Microbiology.				
UNIT-II	The Microbial World				10 hrs.
	Prokaryotic and eukaryotic cell structure, Introduction to different groups of microorganisms such as bacteria, fungi, algae, protozoa, viruses, viroids and prions with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.				
UNIT-III	Methods to study microorganisms				25 hrs.
	Microscopy and staining methods (10 h)				
	Principles of microscopy, the light microscope-components and their functions, variations in light microscopy-bright field, dark field, phase contrast, electron microscope, fundamentals and types. Specimen preparation for different types of microscopy. Stains and staining methods –monochrome staining and negative staining.				
	Culture Methods (10 h)				
	Culture methods in microbiology: basic aseptic technique and good lab practices in microbiology laboratory, biosafety measures and protocols for handling microbial cultures, culture media types and cultivation methods such as solid media, liquid media, aerobic and anaerobic cultivation. Preservation of microbial cultures short term and long term – glycerol stocks, lyophilization, etc.				
Basic Instrumentation (5h)					
Understanding principle and types of basic equipment in microbiological lab: Autoclave, laminar air flow, pH meter, distillation unit, incubators and shakers.					
REFERENCES (Latest edition)					
1.	Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill				
2.	Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers				
3.	Madigan MT, Bender, KS, Buckley DH, Satley, WM and Stahl DA. (2020). Brock Biology of Microorganisms. 16th edition. Pearson				
4	Willey J, Sandman K, and Wood D. (2020) Prescott's Microbiology. 11th edition. McGraw Hill,				
5	Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition, McMillan				

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B.SC. MICROBIOLOGY : HPP					
YEAR	I	CORE MBY1102PT STRUCTURAL COMPONENTS AND BUILDING BLOCKS OF CELLS		CREDIT	2
Semester	I			HOURS	30
OBJECTIVES: To familiarize the students with different structural components of the prokaryotic cell and provide insight into the basic building blocks of macromolecular components of the cell					
COURSE CONTENT / SYLLABUS					
UNIT-I		Prokaryotic cell composition and structure			10 hrs.
		Major and minor elements of cells, structure and functions of plasma membrane, bacterial cell wall structure, peptidoglycan structure, outer membrane of bacterial cells-structure and composition, Gram staining and its principle, difference in gram positive and gram negative cell wall, Inclusion bodies in bacteria with examples-metachromatic granules, polyhydroxybutyrate granules. bacterial flagella, pili, capsule, bacterial spore and sporulating bacteria examples			
UNIT-II		Amino acids and carbohydrates			10 hrs.
		Amino acids as building blocks of protein (5h)			
		Structure and properties of amino acids, peptide bond, pKa and titration curves of amino acids, classification of proteins : structural and functional, globular and fibrous with examples, basic functions of proteins with examples			
UNIT-III		Carbohydrates and polysaccharides (5h)			10 hrs.
		Structure and types of carbohydrates, common aldoses and ketoses, monosaccharides and disaccharides, concept of asymmetric carbon, chirality, and isomerism, glycosidic bond, types Structure and function of major cellular polysaccharides: starch, cellulose, glycogen			
		Lipids and Nucleotides and Methods to study biomolecules			
UNIT-III		Lipid chemistry: (3h)			10 hrs.
		Storage and structural lipids, Fatty acid structure, properties, nomenclature, Phospholipids and sphingolipids, structure and examples			
		Nucleotides as building blocks (2h)			
UNIT-III		Nitrogenous bases, nucleosides and nucleotides. Basic types of nucleic acids, differences in DNA and RNA, types of RNA and their properties and functions			10 hrs.
		Methods to study biomolecules (5h)			
		Chromatography principle, Paper and thin layer chromatography, principle and technique, Spectrophotometry principles and methods of estimation of sugars and lipids, proteins			
REFERENCES (Latest edition)					
1.	Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill				
2.	Willey J, Sandman K, and Wood D. (2020) Prescott's Microbiology. 11th edition. McGraw Hill,				
3.	Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition, McMillan				
4.	Nelson DL and Cox MM (2017) Lehninger Principles of Biochemistry, 7th Edition., W.H. Freeman and Company				
5.	Voet D., Voet JD and Pratt CW (2018) Principles of Biochemistry Global Edn., John Wiley & Sons.				

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<u>B.SC. MICROBIOLOGY : HPP</u>					
YEAR	I	CORE MBY1103PL PRACTICALS		CREDIT	3
Semester	I			HOURS	90
OBJECTIVES:		To provide hands on training of basic microbiological skills such as aseptic technique, microscopy, preparation of laboratory media for culturing microorganisms			
COURSE CONTENT / SYLLABUS					
1.	Demonstration of operation, handling of basic lab equipment: light microscope, autoclave, incubators, shakers, pH meter, distillation unit, weighing balances etc.				
2.	Introduction to good lab practices , Safety in the laboratory, demonstration and practice of aseptic handling between burners and in laminar flow hood.				
3.	Wet mount observations of different fungal cultures to study their morphology				
4.	Observation of different algae such as <i>Chlamydomonas</i> , <i>Volvox</i> using wet mounts				
5.	Observation and identification of different protozoa under wet mount/photographs				
6.	Monochrome staining of different pure cultures of bacteria for understanding cell shape and cellular arrangement				
7.	Negative staining of bacteria				
8.	Preparation of solid and liquid bacteriological media. Preparation of media and glassware for autoclaving e.g. cotton plug making, glassware wrapping , labeling etc.				
9.	Air exposure of solid media for observing air microorganisms, study of colony characteristics				
10.	Cultivation of microorganisms from soil, skin and other natural specimens				
11.	Pure culture isolation and preservation				
12.	Gram staining				
13.	Flagella staining				
14.	Capsule staining				
15.	Spore staining				
16.	Motility by Hanging Drop method				
17.	Qualitative tests for sugar, amino acids and lipids				
18.	Paper chromatography for separation of amino acids				
19.	Thin layer chromatography				
REFERENCES (Latest edition)					
1.	Cappucino J and Welch CT. (2017). Microbiology: A Laboratory Manual. 11th edition. Pearson Education Limited.				
2.	Johnson TD and Case CL (2018) Laboratory Experiments in Microbiology 12 th Edn., Pearson Education Limited.				

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<u>B.SC. MICROBIOLOGY : HPP</u>					
YEAR	I	CORE MBY1201PT		CREDIT	3
Semester	II	FUNDAMENTALS OF BACTERIOLOGY		HOURS	45
OBJECTIVES:		To provide in-depth knowledge of microbial nutrition, growth and its assessment and methods to control unwanted microbial growth.			
COURSE CONTENT / SYLLABUS					
UNIT-I		Bacterial nutrition and nutritional types Requirements of major and micronutrients, types of carbon, nitrogen, phosphorus sources, types of energy metabolism, classification in to nutritional types, examples of heterotrophs, autotrophs, phototrophs etc. Concept of lithotrophy, use of different inorganic molecules as energy source, oxygen and its role in growth, classification on basis of oxygen requirements and examples, modes of anaerobic growth, methodology for enrichment of different nutritional types, culturing methods for anaerobic, photosynthetic, and chemolithotrophic bacteria, Winogradskys column.			15 hrs.
UNIT-II		Bacterial Growth Bacterial growth measurement by different methods, measurement of cfu and serial dilution techniques, turbidimetric measurement of growth, growth curve and phases of growth, types of cultivation methods, batch and continuous culture. Chemostat and turbidostat, Growth equation and parameters such as growth rate, biomass yield etc. Factors affecting growth: pH, temperature			15 hrs.
UNIT-III		Control of microorganisms Concept of sterilization, disinfection, sanitization etc. Overview of Physical and chemical methods for control of micro-organisms, pattern of microbial death and decimal reduction time, principle and application dry heat, moist heat, filtration, radiation. Chemical disinfecting agents examples and mechanisms, application , testing efficacy of disinfection and Phenol coefficient.			15 hrs.
REFERENCES (Latest edition)					
1.		Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill			
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<u>B.SC. MICROBIOLOGY : HPP</u>					
YEAR	I	CORE MBY1202PT BASIC BIOCHEMISTRY		CREDIT	2
Semester	II			HOURS	30
OBJECTIVES:		To provide fundamentals of metabolism such as bioenergetics concepts, central carbohydrate metabolism and enzymes as biological catalysts			
COURSE CONTENT / SYLLABUS					
UNIT-I	Principles of Bioenergetics				10 hrs.
	Laws of thermodynamics, concepts of Gibbs free energy, Chemical equilibria, Relationship between equilibrium constant of reaction and change in free energy, spontaneous and non-spontaneous reactions, exergonic and endergonic reactions, energetics of coupled reactions, concept of high energy compounds and their examples. ATP as the energy currency of cells, concept of catabolism and anabolism, basic processes for generation of ATP: oxidative phosphorylation, photophosphorylation and substrate level phosphorylation.				
UNIT-II	Carbohydrate metabolism				10 hrs.
	Concept of metabolic pathways and their regulation, Glycolysis pathway, enzymes, intermediates, energetics and regulation. Feeder pathways in glycolysis, Fate of pyruvate in different organisms/conditions, lactate, ethanolic and mixed fermentations and examples of organisms, alternate pathways of glucose utilization: Entner Doudoroff pathway and organisms, HMP shunt and its importance, Tricarboxylic acid cycle: enzymes and regulation and energetics. Glyoxalate shunt and Importance. Gluconeogenesis. Glycogen synthesis, regulation.				
UNIT-III	Introduction to enzymes				10 hrs.
	History of enzymes, their discovery, differences in chemical catalysts and enzymes, active site concept, models of enzyme catalysis: Lock and key, Induced fit, classification of enzymes and basic features of 6 classes with examples, enzyme nomenclature with examples, EC number and its significance. Transition state theory, energy diagram showing activation energy, role of catalyst in reduction of activation energy. Concept of reaction rate or velocity, different approaches to measure reaction rate, enzyme assays – continuous and discontinuous assays, examples spectrophotometric assays for different enzymes such as amylase, phosphatase, dehydrogenases. Michelic Menten equation, plot and Km and Vmax definition, Vitamins and cofactors and their role in catalysis, and deficiency disorders				
REFERENCES (Latest edition)					
1.	Nelson DL and Cox MM (2017) Lehninger Principles of Biochemistry, 7th Edition., W.H. Freeman and Company				
2.	Berg JM, Tymoczko JL, Gato GJ and Stryer L (2019) Biochemistry, 9 th Edn., W.H. Freeman and Company				
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YEAR	I	CORE MBY1203PL PRACTICALS		CREDIT	3
Semester	II			HOURS	90
OBJECTIVES:		To provide laboratory skills for isolating pure cultures, enrichment techniques, studying efficacy of ntmicrobial agents and basics of enzyme assays			
COURSE CONTENT / SYLLABUS					
1.	Setting up Winogradskys column and observation of growth zones				
2.	Isolation of different groups of bacteria e.g. amylase producing, protease producing bacteria				
3.	Streak plate method for Isolation of pure cultures				
4.	Instrument handling and operation: Spectrophotometer/colorimeter				
5.	Turbidimetric analysis of bacterial serial dilutions				
6.	Spread plate method for determination of viable count				
7.	Determination of direct microscopic counts				
8.	Cultivation of anaerobic, microaerophilic bacteria from soil by stab methods/paraffin oil method				
9.	Effect of pH on growth				
10.	Efficacy of moist, dry heat and uv radiation on bacteria				
11.	Estimation of sugars by DNSA method				
12.	Estimation of protein by spectrophotometric methods				
13.	Sugar fermentation tests: Observation of acid and gas production from by fermentation				
14.	Numerical problems on bioenergetics				
REFERENCES (Latest edition)					
1.	Cappucino J and Welch CT. (2017). Microbiology: A Laboratory Manual. 11th edition. Pearson Education Limited				
2.	Johnson TD and Case CL (2018) Laboratory Experiments in Microbiology 12 th Edn., Pearson Education Limited				
3.	Principles and techniques of biochemistry and molecular biology- K. Wilson and J. Walker,				