JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program : B.Sc

Proposed Course : Microbiology S.Y.B.Sc Sem IV

Credit Based Semester and Grading System (CBGS) with effect from the academic year 2019-20

S.Y.B.Sc. Microbiology Syllabus

Academic year 2019-2020

Semester IV			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMIC401	**Microbial Biochemistry**	**3**	**3**
UNIT 1	Thermodynamics and Introduction to Metabolism		
UNIT 2	Enzyme Kinetics		
UNIT 3	Transcription and Translation		
SMIC402	**Basics in Immunology and Taxonomy**	**3**	**3**
UNIT 1	Non –specific Host resistance		
UNIT 2	Diagnostic Microbiology		
UNIT 3	Classification and taxonomy		
SMIC 403	**Food and Industrial Microbiology**	**3**	**3**
UNIT 1	Food microbiology		
UNIT 2	Dairy microbiology		
UNIT 3	Industrial Microbiology		
SMIC4PR	Practical	**2.5**	**9**

Semester IV – Theory

Course: SMIC 401	**Course Title: MICROBIAL BIOCHEMISTRY (Credits:03 Lectures/Week:03)**	
	Objectives: ➢ To learn basic concepts of metabolism and bioenergetics ➢ To understand functioning of enzymes ➢ To gain knowledge of process of replication transcription and translation in cells **Outcomes:** On completion of this course, students will learn about metabolism in cells, properties and role of enzymes in metabolism and the molecular mechanisms of synthesis of RNA and proteins	
Unit I	**Thermodynamics and Introduction to Metabolism**	**15 L**
1.	Introduction to metabolism:,Metabolic pathways	02
2.	Organic reaction mechanism	03
3.	Experimental approaches to study metabolism	03
4.	Introduction to Thermodynamics	01
5.	Thermodynamics of Phosphate compounds	03
6.	Oxidation-reduction reactions	02
7.	Thermodynamics of life	01
Unit II	**Enzyme Kinetics**	**15 L**
1	Introduction of Enzymes: General properties of enzymes How do enzymes accelerate reaction Rate, law for a simple catalysed reaction, Michaelis-Menten equation and it's derivation, Lineweaver Burke's plot	05
2	Classification of enzymes	01
3	Overview of Coenzyme: Coenzymes :Different types and reactions catalyzed by c coenzymes(in tabular form) Nicotinic acid: structure, occurrence &biochemical function	02
3	Enzyme Kinetics: Saturation kinetics	03

	Effect of temperature and pH Effect of Inhibitors-Reversible and irreversible, competitive, Non competitive and uncompetitive inhibitors	
4	Multi substrate reactions-Ordered, Random and ping pong reaction	02
5	Allosteric effects in enzyme catalysed reactions- Koshland-Nemethy and Filmer model &Monod, Wyman and Changeux model	02
Unit III	**Transcription and Translation**	**15 L**
3.1	Central Dogma: An Overview, Transcription process, Transcription in bacteria - Initiation of transcription at promoters, elongation of an RNA chain, termination of an RNA chain	**03**
3.2	Transcription in Eukaryotes - Eukaryotic RNA polymerase, Transcription of protein- coding genes by RNA polymerase II, Transcription initiation, The structure and production of Eukaryotic mRNAs, Production of mature mRNA in Eukaryotes, Processing of Pre-mRNA to mature mRNA. Self Splicing of Introns, RNA editing	**05**
3.3	Genetic code - Nature of genetic code and characteristics of genetic code	**02**
3.4	Translation process - Transfer RNA, structure of tRNA, tRNA genes, Recognition of the tRNA anticodon by the mRNA codon, Adding of amino acid to tRNA , Ribosomal RNA and Ribosomes, Ribosomal RNA Genes, Initiation of translation, Initiation in Bacteria, Initiation in eukaryotes, Elongation of the polypeptide chain, termination of translation, protein sorting in the cell.	**05**

Textbooks and Additional References:

1 Russell P. J., iGenetics – A Molecular approach, Pearson Education, Inc., 2nd Ed., 2006.
2 Lehninger A. L., Nelson, D. L., & Cox, M. M., Lehninger principles of biochemistry, New York: Worth Publishers, 5th Ed., 2008.
3 Conn and Stumpf., Outlines of Biochemistry., 5th Ed. Wiley student edition.
4 Garrett and Grisham, Biochemistry. Saunders College Publishing, 2nd Ed.
5 Voet D and Voet J., Biochemistry, Wiley press Edition, 4th Ed.

Course: SMIC402	**Course Title: BASICS IN IMMUNOLOGY AND TAXONOMY (Credits:03 Lectures/Week:03)**	
Objectives:	➢ Study human defence mechanism to infection ➢ Learn and understand the different types and approaches to clinical sample collection, maintenance and laboratory diagnosis ➢ Describe the science of taxonomy and its importance to classification.	
Outcomes	On completion of this course, students will learn about the immune defence mechanisms, diagnostic techniques and science of classification of microorganisms	
Unit I	**Non- Specific Host Resistance**	**15 L**
1.	Types of Immunity **:**Innate, Adaptive, Humoral, Cell mediated	01
2.	Physical barriers in Innate immunity	01
3.	Chemical mediators in Innate immunity	02
4.	Cells and organs of the immune system	04
5.	Phagocytosis and inflammation**:** Mechanisms and link to immunity	03
6.	The Complement System **:**Functions, Complement activation, Biological consequences of complement activation	04
Unit II	**Diagnostic Microbiology**	**15 L**
1.	Overview of the Clinical Microbiology Laboratory	01
2.	Isolation of Pathogens from clinical specimens**:** a. Growth media and Culture b. Collection of specimens, handling and transport c. Types of specimens and their culture **:** Blood, Urine, Faeces, sputum, Cerebrospinal fluid, pus, genital and culture of Anaerobes.	04
3.	Identification of microorganisms from specimens**:** a. Microscopy b. Growth-Dependent Identification Methods	02
4.	Rapid Methods of Identification	02
5.	Bacteriophage Typing	02
6.	Molecular Methods and Analysis of Metabolic Products: a. Nucleic Acid –Based Detection Methods b. Gas liquid Chromatography c. Plasmid Fingerprinting	04

Unit III	Classification and Taxonomy	15 L
1.	Introduction to microbial taxonomy**:** a. Systems of classification(Cavalier Smith 6 kingdom) b. Bergey's manual c. The three domain concept based on phylogeny d. Nomenclature e. Taxonomic ranks f. Numerical Taxonomy	04
2.	Methods of analysis used in classification**:** Phenotypic analysis a. Morphological characteristics b. Physiological and metabolic characteristics, c. Biochemical characteristics d. Ecological characteristics e. Fatty acid analysis	02
3.	Genetic analysis**:** a. DNA-DNA hybridization b. DNA profiling c. Multilocus sequence analysis d. G+C ratio e. Genetic finger printing	04
4.	Amino acid sequencing	01
5.	Phylogenetic analysis**:** a. Nucleic acid sequencing b. Analysis of individual genes c. Multilocus gene sequence analysis d. Whole genome sequence analysis	03
6.	Phylogenetic tree Construction	01

Course: SMIC403	Course Title: FOOD AND INDUSTRIAL MICROBIOLOGY (Credits:03 Lectures/Week:03)	
Objectives:	➢ To learn factors affecting growth of microorganisms in food, food spoilage by microorganism and food pathogens ➢ To understand dairy microbiology ➢ To learn basic aspects of Fermentation, types of fermentation, fermenter design.	
Outcomes:	On completion of this course, students will learn about: The principles of food spoilage and its impact on human health. The different techniques involved in food preservation and the criteria for checking food quality Microbiology of dairy products and the tests to check the quality of dairy products Manufacturing of important Dairy products The basic aspects of fermentation, types of fermentation, the basic design of a fermenter and the function of each part.	
Unit I	**Food Microbiology**	**15 L**
1.	Factors affecting the growth and survival of microorganisms in food a) Intrinsic factors (Nutrient Content, pH, Eh, Antimicrobial barriers & constituents, Water activity) b) Extrinsic factors (Relative humidity, Temperature, Gaseous atmosphere) c) Implicit factors (Specific growth rate, Mutualism, Antagonism, Commensalism)	05
2.	General principles underlying spoilage: Chemical changes caused by microorganisms a) Causes of spoilage b) Classification of food by ease of spoilage c) Chemical changes caused by microorganisms	02
3.	Food Microbiology & Public health a) Food-borne diseases b) Significance of food- borne disease c) Microbiological agents of food-borne illness (tabular form) d) Risk factors associated with food-borne illness e) Changing scene & emerging pathogens	03
4.	Controlling the microbiological quality of food	01

	a) Quality & Criteria b) HACCP Concepts with an example	
5.	Microbiology of food preservation a) Heat Processing (Pasteurization, Appertization, Aseptic packaging) b) Irradiation – Ionizing radiation c) Low temperature storage d) Chemical preservatives (Organic acids, nitrites, sulphur dioxide, natural food preservatives) e) Control of water activity f) Modification of atmosphere	04
Unit II	**Dairy Microbiology**	**15 L**
1.	Microbiology of Raw Milk, a) Microorganisms associated with raw milk (indigenous microflora and contaminant microorganisms) b) Types of spoilage microorganisms (Psychrotrophic, Thermoduric, Sporeforming, Coliforms, LAB, Yeasts and Molds). c) Important pathogenic microorganisms in raw milk d) Sources of contamination of milk	04
2.	Improving microbial quality of raw milk a) Antimicrobial factors of raw milk (Lactoferrin, Immunoglobulin , Lysozyme) b) Refrigeration during collection and storage of raw milk Thermal treatment during collection and storage of raw milk	02
3.	Analysis of Milk a) Grading of Milk, Platform tests, Dye reduction test, DMC, SPC, LPC, Coliform count, Thermophilic count, Psychrophilic count b) Rapid detection of milk borne pathogens (Nucleic acid based assays, Immunological based assays, Biosensors)	03
4.	Dairy starter cultures: Classification of starter culture	01
5.	Milk products: a) Cheese	05

	• Classification & Types • Manufacture of Cheddar Cheese • Defects of cheese • Processed cheese b) Butter • Classification & Composition • Manufacture of Butter • Defects of Butter c) Yoghurt • Classification & Types • Manufacture of set & stirred type yoghurt • Defects of yoghurt	
Unit III	**Industrial Microbiology**	**15 L**
1.	Concept of Fermentation technology	01
2.	Range of fermentation processes and products (enlist with definitions and examples)	
3.	The fermentation process outline	
4.	Fermentation Media a) Criteria for an ideal fermentation media b) Types and composition of fermentation media (simple, complex, crude and synthetic) c) Raw materials for fermentation media • Carbon sources- Carbohydrates, molasses and its types, barley, Sulphite waste liquor, Oils, fats and hydrocarbons • Nitrogen sources- Inorganic and synthetic organic nitrogen sources and natural sources (Corn steep liquor, Soyabean meal) • Growth factors • Inorganic mineral salts • Buffers • Precursors • Inhibitors	03

	• Inducers • Antifoam agents • Water	
5.	Screening –Primary and Secondary (Antibiotics and amino acids)	02
6.	Preparation of inoculum	02
7.	Types of Fermentations – a) Anaerobic b) Surface c) Submerged d) Batch e) Fed-batch f) Continuous g) Solid substrate h) Dual or multiple fermentation	03
8.	Fermenter Design a) Bioreactor b) Functions of Fermenter c) Fermenter and its components • Vessel shape • Temperature control • Aeration and agitation • Agitator or impeller • Stirrer and bearings • Baffles • Sparger • Air filter system • Sampling and feed ports • Sensor probes • Foam Control • Valves • Steam traps • Reflux cooler and air exhaust	04

	• Seals	

Textbooks and Additional References:

1 CasidaL.E. (2009).Industrial Microbiology Reprint, New Age International (P) Ltd, Publishers, New Delhi.

2 Prescott and Dunn's. (1982). Industrial Microbiology Ed. 4th, McMillan Publishers

3 Frazier. (2018).*Food Microbiology* 5th ed McGraw Hill Education (India) private limited.

4 K.C Mahanta. (1984). Dairy microbiology 1 st Ed. Omson Publication.

5 Adam and Moss (2008) Food Microbiology, 3rd Ed. New Age International Ltd.

6 Eckles. (1986). Milk and milk products 4th Ed Tata McGraw Hill Publishing company Ltd.

7 Sukumar De (1980) Outlines of dairy technology 13th Ed. Oxford University Press.

8 Barbaros, Ozer.(2014) Diary microbiology and Biochemistry: Recent development 1st Ed. London, Crc Press

9 R. Puvanakrishnan, S. Sivasubramanian. (2012). Microbial technology: concepts and application 1st Ed. Chennai MJP Publishers

10 H.A.Modi,(2009*)*.FermentationTechnology''Vol.1&2, Pointer Publications, India

Course Code SMIC4PR	Semester IV – Practical	2.5 Credit
PRACTICAL – I	**Course Title: Microbial Biochemistry**	
Learning Objectives:	➢ Practical Aspects of Enzymology	
	1. Effect of pH, Temp, substrate and enzyme concentration on activity of the enzyme. 2. Determination of Km and Vmax of the enzyme.	
PRACTICAL – II	**Course Title: Taxonomy and Basics in Immunology**	
Learning Objectives:	➢ Basic laboratory methods used for identification of Bacteria ➢ Principle of different media and biochemical tests ➢ The different cells present in human blood, their proportion and properties	
	1. Differential Staining of blood cells 2. Pyocin typing 3. Bacteriophage typing (Demo) 4. Use of Selective and Differential Solid Media: SS agar, XLD agar, TCBS agar, SIBA, Salt Mannitol agar, CLED agar, Hoyle's tellurite agar 5. Use of Biochemical Media/Tests for Identification of Pathogens: Carbohydrate fermentation, Indole test, Methy Red test, Vogues Proskauer test, Citrate Utilization, Lysine Decarboxylase, Gelatin Liquefaction, Nitrate Reduction, Phenylalanine deaminase test, Urease test, TSI agar, Oxidase test, Catalase test, Bile solubility test, Coagulase test, Optochin test and Bacitracin test. 6. Rapid Identification of a Pathogen using a Kit (Demonstration)	
PRACTICAL - III	**Course Title: Course Title: Food and Industrial microbiology**	
Learning Objectives	➢ To understand the role of microorganisms in food spoilage. ➢ To learn the principles and methods underlying food preservation. ➢ To perform Rapid platform tests used to check the	

	quality of milk.	
	1. Isolation of food spoilage agent 2. Determination of TDT and TDP 3. Determination of MIC (Salt) 4. RPT of Milk–RRT,MBRT,DMC 5. Check efficiency of Pasteurization – Phosphatase test 6. Microbiological quality control of Milk and milk products (Butter & Cheese) 7. Primary Screening – Antibiotic producers 8. Agar Streak plate and Strip plate method	
	PROJECT	

Evaluation Scheme

[A] Evaluation scheme for Theory courses

I. Continuous Assessment (C.A.) - 40 Marks

(i) C.A.-I : Test – 20 Marks of 40 mins. Duration

(ii) C.A.-II : Type Name (Assignment/Project etc.)

II. Semester End Examination (SEE)- 60 Marks

[B] Evaluation scheme for Practical courses (SEE) 100 Marks

Including Project