



**JAI HIND COLLEGE
BASANTSING INSTITUTE OF
SCIENCE**

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**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

Semester IV

**Credit Based Semester and Grading System (CBGS) with effect
from the academic year 2020-21**

S.Y.B.Sc. Microbiology Syllabus

Academic year 2020-2021

| 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 | | |
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| SMIC 403 | Food and Industrial Microbiology | 3 | 3 |
| UNIT 1 | Food microbiology | | |
| UNIT 2 | Dairy microbiology | | |
| UNIT 3 | Industrial Microbiology | | |
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| SMIC4PR | Practical | 2.5 | 9 |
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Semester IV – Theory

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| Course: SMIC 401 | Course Title: MICROBIAL BIOCHEMISTRY (Credits:03 Lectures/Week:03) | |
| | <p>Objectives:</p> <ul style="list-style-type: none"> ➤ 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 <p>Outcomes:</p> <p>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</p> | |
| 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 | <p>Introduction of Enzymes:</p> <ul style="list-style-type: none"> a. General properties of enzymes b. How do enzymes accelerate reaction rate, law for a simple catalysed reaction, c. Michaelis-Menten equation and its derivation d. Lineweaver Burke's plot | 05 |
| 2 | Classification of enzymes | 01 |
| 3 | <p>Overview of Coenzyme:</p> <ul style="list-style-type: none"> a. Coenzymes :Different types and reactions catalyzed by coenzymes(in tabular form) b. Flavoproteins and Nicotinic acid: structure, occurrence & biochemical function | 02 |

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| 3 | Enzyme Kinetics: a. Saturation kinetics b. Effect of temperature and pH c. Effect of Inhibitors-Reversible and irreversible, competitive, Non competitive and uncompetitive inhibitors | 03 |
| 4 | Multi substrate reactions-Ordered, Random and ping pong reaction | 02 |
| 5 | Allosteric effects in enzyme catalysed reactions- 1. Kinetics of allosteric enzymes 2. Models of Allosteric enzymes: Koshland-Nemethy and Filmer model & Monod, Wyman and Changeux model | 02 |
| Unit III | Transcription and Translation | 15 L |
| 1 | Central Dogma: An Overview Transcription in bacteria - Initiation of transcription at promoters, elongation of an RNA chain, termination of an RNA chain | 03 |
| 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 | Genetic code - Nature of genetic code and characteristics of genetic code | 02 |
| 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.

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| Course: SMIC402 | Course Title: BASICS IN IMMUNOLOGY AND TAXONOMY (Credits:03 Lectures/Week:03) | |
| Objectives: | <ul style="list-style-type: none"> ➤ Study human defence mechanism toinfection ➤ Learn and understand the different types and approaches to clinical sample collection, maintenance and laboratorydiagnosis ➤ Describe the science of taxonomy and its importance toclassification. | |
| 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. | | 02 |
| | rs in Innate immunity | |
| 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: <ul style="list-style-type: none"> a. Types of specimens and their culture: Blood, Urine,Faeces, sputum, Cerebrospinal fluid, pus, genital specimen. b. Collection of specimens, handling andtransport c. Growth media and Culture ofspecimen | 05 |
| 3. | Identification of microorganisms from specimens: <ul style="list-style-type: none"> a. Microscopy b. Growth-Dependent IdentificationMethods | 02 |
| 4. | Rapid Methods of Identification | 02 |
| 5. | Bacteriophage Typing | 01 |
| 6. | Molecular Diagnostic Methods | 02 |
| 7. | Antigen Detection and Western Blot immunoassays | 02 |
| Unit III | Classification and Taxonomy | 15 L |
| 1. | Introduction to microbial taxonomy: <ul style="list-style-type: none"> a. Systems of classification(Cavalier Smith 6 kingdom) | 04 |

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| | <ul style="list-style-type: none"> b. Bergey's manual c. The three domain concept based on phylogeny d. Nomenclature e. Taxonomic ranks f. Numerical Taxonomy | |
| 2. | Methods of analysis used in classification: Phenotypic analysis <ul style="list-style-type: none"> a. Morphological characteristics b. Physiological and metabolic characteristics, c. Biochemical characteristics d. Ecological characteristics e. Fatty acid analysis | 02 |
| 3. | Genetic analysis: <ul style="list-style-type: none"> a. DNA-DNA hybridization b. DNA profiling c. Multilocus sequence analysis d. G+C ratio e. Genetic fingerprinting | 04 |
| 4. | Amino acid sequencing | 01 |
| 5. | Phylogenetic analysis: <ul style="list-style-type: none"> 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 |

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| Course: SMIC403 | Course Title: FOOD AND INDUSTRIAL MICROBIOLOGY (Credits:03 Lectures/Week:03) | |
| Objectives: | <ul style="list-style-type: none"> ➤ 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: | <p>On completion of this course, students will learn about:</p> <ul style="list-style-type: none"> 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. | <p>Factors affecting the growth and survival of microorganisms in food</p> <ul style="list-style-type: none"> 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. | <p>General principles underlying spoilage: Chemical changes caused by microorganisms</p> <ul style="list-style-type: none"> a) Causes of spoilage b) Classification of food by ease of spoilage c) Chemical changes caused by microorganisms | 02 |
| 3. | <p>Food Microbiology & Public health</p> <ul style="list-style-type: none"> 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 |

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| | <ul style="list-style-type: none"> a) Quality &Criteria b) HACCP Concepts with an example | |
| 5. | <p>Microbiology of food preservation</p> <ul style="list-style-type: none"> 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. | <p>Microbiology of Raw Milk,</p> <ul style="list-style-type: none"> a) Microorganisms associated with raw milk (indigenous microflora and contaminant microorganisms) b) Types of spoilage microorganisms (Psychrotrophic, Thermophilic, Sporeforming, Coliforms, LAB, Yeasts and Molds). c) Important pathogenic microorganisms in raw milk d) Sources of contamination of milk | 04 |
| 2. | <p>Improving microbial quality of raw milk</p> <ul style="list-style-type: none"> a) Antimicrobial factors of raw milk (Lactoferrin, Immunoglobulin, Lysozyme) b) Refrigeration during collection and storage of raw milk <p>Thermal treatment during collection and storage of raw milk</p> | 02 |
| 3. | <p>Analysis of Milk</p> <ul style="list-style-type: none"> 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. | <p>Milk products:</p> <ul style="list-style-type: none"> a) Cheese | 05 |

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| | <ul style="list-style-type: none"> • Classification &Types • Manufacture of CheddarCheese • Defects ofcheese • Processedcheese <p>b) Butter</p> <ul style="list-style-type: none"> • Classification &Composition • Manufacture ofButter • Defects ofButter <p>c)Yoghurt</p> <ul style="list-style-type: none"> • Classification &Types • Manufacture of set & stirred typeyoghurt • Defects ofyoghurt | |
| 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. | <p>Fermentation Media</p> <p>a) Criteria for an ideal fermentationmedia</p> <p>b) Types and composition of fermentation media (simple, complex, crude andsynthetic)</p> <p>c) Raw materials for fermentationmedia</p> <ul style="list-style-type: none"> • Carbon sources- Carbohydrates, molasses and its types, barley, Sulphite waste liquor, Oils, fats andhydrocarbons • Nitrogen sources- Inorganic and synthetic organicnitrogen sources and natural sources (Corn steep liquor, Soyabean meal) • Growthfactors • Inorganic mineralsalts • Buffers • Precursors • Inhibitors | 03 |

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| | <ul style="list-style-type: none"> • Inducers • Antifoamagents • Water | |
| 5. | Screening –Primary and Secondary (Antibiotics and amino acids) | 03 |
| 6. | Fermentation Economics | 01 |
| 7. | Types of Fermentations – <ul style="list-style-type: none"> a) Anaerobic b) Surface c) Submerged d) Batch e) Fed-batch f) Continuous g) Solidsubstrate h) Dual or multiplefermentation | 03 |
| 8. | Fermenter Design <ul style="list-style-type: none"> a) Bioreactor b) Functions ofFermenter c) Fermenter and itscomponents <ul style="list-style-type: none"> • Vesselshape • Temperaturecontrol • Aeration andagitation <ul style="list-style-type: none"> • Agitator orimpeller • Stirrer andbearings • Baffles • Sparger • Air filtersystem • Sampling and feedports • Sensorprobes • FoamControl • Valves • Steamtraps • Reflux cooler and airexhaust | 04 |

Textbooks and Additional References:

- 1 Casida L.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 1st 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) Dairy microbiology and Biochemistry: Recent development 1st Ed. London, Crc Press
- 9 R. Puvanakrishnan, S. Sivasubramanian. (2012). Microbial technology: concepts and application 1st Ed. Chennai MJ Publishers
- 10 H.A. Modi, (2009). Fermentation Technology'' Vol.1&2, Pointer Publications, India

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| 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 K_m and V_{max} 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. Pyocotyping 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, Methyl 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 | |

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| | quality of milk. | |
| | <ol style="list-style-type: none"> 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