Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College" Affiliated to

KBC North Maharashtra University, Jalgaon

SYLLABUS

Microbiology

S.Y.B.Sc

(Semester III & VI)

Under Choice Based Credit System (CBCS)

[w. e. f. Academic Year: 2020-21]

Course Structure: S.Y.BSc. (Microbiology) (CBCS) Semester III and IV

Duration: The duration of B.Sc. (Microbiology) degree program shall be three years.

Semester	Course Module	Subject code	Title of Paper	Credit	Hours per week
III	DSC	MB-231	Fundamentals of biochemistry	2	2
	DSC	MB -232	Basic medical microbiology and bio-techniques	2	2
	DSC	MB -233	Practical course based on MB-231 and MB-232	2	4
	SEC	MB -230	Microbiological analysis of air, water and soil	2	2
IV	DSC	MB -241	Basic genetics and immunology	2	2
	DSC	MB -242	Basic industrial microbiology	2	2
	DSC	MB -243	Practical course based on MB-241 and MB-242	2	4
	SEC	MB -240	Food and dairy microbiology	2	2

DSC : Discipline Specific Elective Core Course
SEC : Skill Enhancement Course
MB-YSC : Microbiology (Y-year; S-Semester; C-Course number)

Examination Pattern for S.Y.B.Sc.

Examination	Marks
External Marks	**40**
Internal Marks	**10**
Total Marks	**50**

S.Y. B.Sc. (Microbiology): Semester-III

MB-231: Fundamentals of biochemistry

Hours: 30 **Credits: 2**

Course objectives:

- To acquaint students with basic concepts of biomolecules.
- To understand the concepts and terminologies in enzymology.
- To introduce the basics of microbial metabolism.

Course outcomes:

After completion of this course, students will be able to

- Cognizant the basic structure, classification and functions of biomolecules with examples.
- Understand the classification and mechanism of microbial enzymes action.
- Aware about concept and fundamental pathways of metabolism.

Unit I: Biomolecules I **10h**

- Carbohydrates: Definition and general functions
- Classification: Mono, Oligo and Polysaccharide
- Structure and biological role of microbiological carbohydrates: Glucose, lactose, starch and peptidoglycan
- Amino acids and Proteins
  - Basic structure and properties of amino acids
  - Classification of amino acids based on R group, solubility and polarity
  - Definition and general functions of protein
  - Classification of protein (based on shape, composition, solubility and functions)
  - Chemical bonds in protein structure (Covalent, hydrogen, hydrophobic, electrostatic, van der Waal's forces)
  - Structural levels of protein organization: Primary, secondary, tertiary and quaternary

Unit II: Biomolecules II **10h**

- Fatty acid and Lipids
  - Fatty acids: Definition, nomenclature, Types with example (saturated, unsaturated)
  - Lipid: Definition and general function
  - Classification of lipids: simple, compound/ complex, derived
  - Structure and biological significance of Triglyceride, phospholipids, glycolipids and sterols
- Nucleic acid
  - Structural constituents of nucleic acids: sugar, phosphodiester bond, nitrogen bases (purines and pyrimidines)
  - Concept of nucleoside and nucleotide
  - DNA: Structure (Watson and Crick Model), Chargaff's Rule, circular and super coiled DNA
  - RNA: Structure and significance of : mRNA, tRNA and rRNA, hnRNA
  - Forms of DNA: A, B and Z (structure and differences) and unusual structures of DNA

Unit III: Introduction to enzyme and metabolism **10h**

- Enzyme
  - Definition, General properties of enzymes
  - Concepts in enzymology: units of enzyme activity, specific activity, cofactors, prosthetic groups, apoenzyme, holoenzyme, active site
  - Enzyme nomenclature and classification (IUBMB), Significance of numbering system
  - Mechanism of enzymes catalysis:
    - Lowering of activation energy
    - Fischer's Lock and key hypothesis
    - Koshland's Induced fit hypothesis
  - Effect of substrate concentration, temperature, pH, activators and inhibitor on the enzyme
    - Michaelis-Menten equation, Km, Vmax, and Kcat concept
  - Applications of various microbial enzymes in different fields
- Metabolism
  - Overview of metabolism: anabolism and catabolism
  - Basic metabolic pathway: Glycolysis and Kreb's cycle

References:

1. Lehninger, A I. (2013) Principles of Biochemistry, 6th edn., Nelson, D L and Cox, M. M. (eds.) WH Freeman and Co., New York.
2. Moat, A. and Foster, J. (2002) Microbial Physiology, 4th edn., Wiley Interscience Publications, New York.
3. Gottschalk, G. (1986) Bacterial Metabolism, 2nd edn., Springer- Verlag
4. Stryer, L. (2001) Biochemistry, 5th edn., WH Freeman and Co., New York.
5. Stanier RY, Ingraham JL, Wheelis ML, Painter PR (1995) General Microbiology, 5th Edition, MacMillan Press Ltd., London.
6. Prescott, L. M., Hartley, J. P. and Klein, D. A. (1993) Microbiology, 2nd Ed., W. M. C. Brown Publ., England
7. Tortora, G. J., Funke, B. R. and Case, C. L. (2004) Microbiology, 8th Edn., Person Education, New Delhi
8. Nicholas, C.P. and Lewis, S. (1999) Fundamentals of Enzymology, 3rd edn., oxford University Press Inc. New York
9. Caldwell, D.R. (1995) Microbial Physiology and Metabolism, Brown Publishers, London
10. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. (2013) Prescott's Microbiology, 9th edn., MacGraw Hill Higher Education
11. Satyanaryana U (2005) Biochemistry, Books and Allied P Ltd., Kolkata

Proposed methods of teaching/ innovative teaching:

Classroom teaching - lecture method, Group discussion, seminars, moodle, Google Classrooms, audio-visuals (power point presentations), assignments, quiz, etc.

S.Y. B.Sc. (Microbiology): Semester-III

MB-232: Basic medical microbiology and bio-techniques

Hours: 30 **Credits: 2**

Course objectives:

- To complement the students with the basic knowledge of medical microbiology
- To study the advance microscopic techniques
- To aware about the bio analytical techniques

Course outcomes:

After completion of this course, students will be able to

- Understand the advance microscopy with respect to principle, working and applications.
- Cognizant with different basic concepts of medial microbiology.
- Understand the Principle, method and applications of bio analytical techniques.

Unit I: Concepts in Medical Microbiology **10h**

- Normal flora of human body
- Concept of Human microbiome
- Portal of entry of pathogen
- Stages of infectious diseases
- Virulence factors: Invasiveness and Toxigenicity
- Pattern of disease: chronic and acute
- Signs, symptoms and syndrome
- Laboratory diagnosis
- Prophylaxis
- Treatment
- Epidemiology
- Concept of outbreak with example of COVID-19
- Introduction to CDC and WHO; their efforts in various epidemics, pandemics and diagnosis andcontrol of community infection

Unit II: Advance Microscopy **10h**

- Principle, working, ray diagram and applications of :
  - Phase contrast microscopy
  - Fluorescence microscopy
  - Transmission Electron microscopy (TEM)
  - Scanning Electron microscopy (SEM)
  - Scanning Tunneling Microscopy (STM)
- Specimen preparation for TEM: Negative staining, thin sectioning (ultra-microtomy)
- Specimen preparation for SEM: Surface replicas, Freeze etching, shadow casting
- Limitations of electron microscope

Unit III: Bio analytical technique **10h**

- Principal, method and applications of
  - Colorimetry and Spectrophotometry
    - Concept of electromagnetic radiation
    - Absorption spectrum, Beer's and Lambert's law
    - UV/ Visible spectrophotometry

- Chromatography
  - Paper and Thin layer
- Electrophoresis:
  - Agarose gel, Poly acrylamide gel (PAGE), SDS-PAGE

References:

1. Kathy Talaro and Barry Chess (2012) Foundations in Microbiology, The McGraw-Hill Companies, Inc., New York.
2. Tortora, Funke and Case (2010) Microbiology, Brenjamin Cummings Inc., California
3. Stanier, R.Y., Ingraham, J.L., Wheelis M.L., Painter R.K. (1995) General Microbiology, MacMillan Press Ltd. London.
4. Frobisher M. (1974) Fundamentals of Microbiology, Hinsdill, Crabtree and Goodheart Ed., WB Saunder's Co. USA.
5. Pelczar MJ, Chan ECS, Krieg NR (1998) Microbiology Tata McGraw Hill Publishing Co. Ltd. New Delhi.
6. Modi H. A. (1995) Elementary Microbiology 1 and 2, Ekta Prakashan, Ahmedabad
7. Wilson K and Walker J (2006)Principles and techniques of practical biochemistry (5th Ed.):Cambridge University Press, Cambridge,
8. Frontmatter. (2018). In A. Hofmann & S. Clokie (Eds.), Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (pp. I-Iv). Cambridge: Cambridge University Press.
9. Upadhyay A, Upadhyay K., Nath N. (1998) Biophysical chemistry: Principal and techniques, Himalaya Publishing House. Mumbai
10. Sivasankar B (2005) Bioseparations: Principal and techniques, Printice-Hall of India Pvt. Ltd. New Delhi
11. Bajpal P. K. (2006) Biological instrumentation and methodology, S. Chand, New Delhi
12. Marimuthu R. (2008) Microscopy and microtechnique, MJP publisher, Chennai

Proposed methods of teaching/ innovative teaching:

Classroom teaching - lecture method, Group discussion, seminars, moodle, Google Classrooms, audio-visuals (power point presentations), assignments, quiz etc.

S.Y. B.Sc. (Microbiology): Semester-III

MB-233: Practical course based on MB-231 and MB-232

Hours: 60 **Credits: 4**

Course objectives:

- To study techniques for detection of various microbial enzymes
- To analyse the water quality, microflora of skin
- To analyse the biomolecules in qualitative and quantitative manner
- To study structural details of microbial cell

Course outcomes:

After completion of this course students will be able to

- Perform experiment with screening of microbe for enzyme and enzyme assay
- Analyze water quality, skin flora,
- Estimate basic biomolecules in qualitative and quantitative manner.

1. Cell wall staining by any suitable method.
2. Flagella staining by any suitable method.
3. Study of skin microflora using swab technique
4. Presumptive Coliform test for checking potability of water (MPN).
5. Confirmed and Completed Coliform test for assessing potability of water.
6. Detection of microbial enzymes from microbes: Amylase, Lipase, Gelatinase.
7. Detection of microbial enzymes from microbes: Catalase, Urease, Coagulase.
8. Enzyme activity assay (amylase/ protease/ cellulase)
9. Qualitative test for sugar, protein and lipids
10. Preparation of standard curve of protein using Folin-Lowery method
11. Preparation of Buffers (0.1 M Phosphate Buffer - 6.8 to 7.4)
12. Handling and calibration of pipette, volumetric flask and pH meter and demonstration of handling of micropipette

References:

1. Alcamo, I.E. (2001) Laboratory Fundamentals of Microbiology, Jones and Bartlett,
2. Aneja, K.R (1996) Experiments in Microbiology, 3rd edition, Wishwa Prakashan, New Delhi.
3. Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York.
4. Dubey, R.C. and Maheshwari D. K (2004) Practical Microbiology, S. Chand and Co., New Delhi.
5. Harley, J.P. and Prescott, L.M (1996) Laboratory Exercise in Microbiology, 3rd edition, WCB/McGraw Hill.
6. Jayaraman, I. (1981) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi.
7. Norris, J.R. (1969) Methods in Microbiology Vol. I, 1st Edn. Academic Press Inc., London.
8. Parija, S.C. (2007) Textbook of Practical Microbiology, Ahuja Publishing House, New Delhi.
9. Plummer, D.T. (1992) An Introduction to Practical Biochemistry, Tata McGraw Hill Publisher, New Delhi.
10. Sharma, K. (2007) Manual of Microbiology Tools and Techniques, Anne's Book India, New Delhi.

Proposed methods of teaching/ innovative teaching:

Demonstration methods, hands on experiments, virtual labs/e-content available online, Group discussion, audio-visuals (power point presentations), computational thinking

S.Y. B.Sc. (Microbiology): Semester-III

MB -230: Microbiological analysis of air, water and soil

Hours: 30 **Credits: 2**

Course objectives:

- To highlight the importance of air, water and soil microbiology.
- To impart the skills of environmental analysis.
- To describe the key preventative and monitoring actions which maintain and improve microbiological quality of water, air and soil.

Course outcomes:

After completion of this course students will be able to

- Understand the skill sets in assessment and enumeration of air, water and soil quality
- Aware about the biogeochemical cycles and ecological aspects of microbiology.
- Understand the concepts of pollution, indicator bacteria, Water and air-borne diseases

Unit I: Air microbiology **10h**

- Terminologies in aero microbiology: Bio-aerosols, droplet nuclei, air borne microbes, allergens
- Significance in human health, environmental, food and pharmaceutical industries, surgical operations.
- Techniques for microbial sampling of air from various sources, aerosol sampling, fate of aerosols, inactivation by UV light and HEPA filter
- Assessment of air quality by solid, liquid impingement,
- Air borne transmission of microbes, their diseases and preventive control measures

Unit II: Soil microbiology **10h**

- Soil horizons, classification of soils and Rhizosphere microflora
- Biogeochemical cycles: C, P, N, S
- Winogradsky's column to study soil microflora
- Enumeration of soil microflora by different techniques

Unit II Water microbiology **10h**

- Water ecosystem: Fresh water, Marine water
- Microflora of water
- Bacterial assessment of water and potability of water: TVC, MPN
- Indicator bacteria: *E. coli, Streptococcus fecalis* and *Staphylococcus aureus*,
- Physiochemical characteristics of water with permissible limits: TSS, TDS, DO, BOD, COD
- Brief account of water borne diseases and their control measures: Cholera, Typhoid

References:

1. Clesceri L S., Greenberg, A. E, and Eaton A. D. (1998) Standard Methods for Examination of Water and Wastewater, 18th Edition, American Public Health Association, Washington.
2. Maier R.M., pepper, I.L. and Gerba, C.P. (2009) Environmental Microbiology, 2nd edn., Academic Press, NY.
3. Salle, S.J. (1974) Fundamental Principals of Bacteriology, 2nd edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

4. SubbaRao, N.S. (1999) Soil Microbiology, 4th edn., Oxford and IBH Publ. Co., New Delhi.
5. Coyne, M.S. (2001) Soil Microbiology: An Exploratory Approach, Delmar Thomson Learning.
6. Alexander, M. (1977) Introduction to Soil Microbiology, John Wiley and sons Inc. New York.
7. Bums, R.G. and Slater, J.H. (1982) Experimental Microbial Ecology, Blackwell Scientific Publ., Oxford.
8. Atlas, R.M. and Bartha, R. (2000) Microbial Ecology, 4th edn., Benjamin/Cumming Science Publ., USA.
9. Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York.
10. Dubey, R.C. and Maheshwari D.K (2004) Practical Microbiology, S. Chand and Co. New Delhi.
11. Harley, J.P. and Prescott, L.M (1996) Laboratory Exercise in Microbiology, 3rd edition, WCB/McGraw Hill, London.

Proposed methods of teaching/ innovative teaching:
Classroom teaching - lecture method, Group discussion, seminars, moodle, Google Classrooms, audio-visuals (power point presentations), assignments, quiz, etc.

S.Y. B.Sc. (Microbiology): Semester-IV
MB-241: Basic genetics and immunology

Hours: 30 **Credits: 2**

Course objectives:
- To acquaint students with basic concepts of microbial genetics.
- To understand the basics of mutation and its repair mechanism.
- To introduce the basics of microbial infection and immunology.

Course outcomes:
After completion of this course students will be able to
- aware the basics concepts of genomics related to pro and eukaryotic
- Understand the organization of chromosome, plasmid and mechanism of mutation
- Understand the concepts of genetic code, mutation and repair mechanism
- Cognizant with the basic topics related to infection and immunology

Unit I: Genes and chromosomes **10h**
- Concepts in basic genetics: Gene, allele, genome, genotype, phenotype, cistron, intron and exon, haploid, diploid, partially diploid, homologous, heterologous.
- Prokaryotic genetic material:
  - Typical structure of chromosome
  - Plasmid : Concept, types and properties

- Eukaryotic chromosome
  - Structural organization
  - Concept of : Euchromatin and Heterochromatin
  - Chromosome variation: Euploidy, Aneuploidy, Polyploidy
- Genetic code and its properties

Unit II: Mutations **10h**

- Concept and significance of mutation
- Types of mutation : Base pair substitutions (transition, transversion), deletion, inversion, insertions missense, nonsense, neutral, silent, frame shift, reverse and suppressor mutations
- Spontaneous mutations: mechanism
- Induced mutations: Physical
  - Radiation: UV, Gamma, and X- rays,
  - Chemical: Base analogues, deaminating agents, alkylating agent, intercalating agent)
- Methods to study/screen mutation:
  - Fluctuation test,Replica plate technique, Ames test
- Repair of Mutation: photo activation, excision repair

Unit III: Infection and Immunity **10h**

- Infection: types, mode and sources of transmissions
- Immunity: concept, types (Innate, Acquired), components and properties of immune system
- Immune cells: stem cell, T cell, B cell, NK cell, Macrophages, Dendriticcell
- Organs involved in immune response: Primary (Bone marrow, thymus), Secondary (lymph node, spleen, GALT, payers patches)
- Immune response: Non-specific, specific immune response, Humoral and cell mediated
- Antigen: Concept of hapten, adjuvants, immunogen, epitope and paratope, types and properties
- Antibody: structure of prototypic antibody (IgG), types and functions (Ig A, Ig M. Ig D. Ig E)

References:

1. Wiley, J M, Sherwood, L M and Woolverton, C J. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International, New York.
2. Frobisher M. Hinsdill, Crabtree and Goodheart (1974) Fundamentals of Microbiology, 9th edition, WB Saunder's Co., USA.
3. Madigan M T, Martinko J M, Dunlap P V and Clark D P. (2014) Brock Biology of Microorganisms, 14th edition, Pearson International Edition, New Delhi
4. Tortora, Funke and Case (2010) Microbiology, 10th edition, Brenjamin Cummings Inc, California.
5. Modi, H. A. (2014) Elementary Microbiology, Vol. 1 and 2, AksharPrakashan, Ahmedabad.
6. Pawar, C B, and Daginawala, HF. (1998) General Microbiology, Vol. I and II, 1st edition, Himalaya Publishing House, Mumbai.
7. Ananthanarayan, P., Paniker, C. K. J. (1990) Textbook of Microbiology, Orient Longman, Madras.

8. Kimball, J. W. (1990) Introduction to Immunology, MacMillan Publishing Company, New York.
9. Kuby, J. W. H. (1994) Immunology, W.H. Freeman and Company, New York.
10. Riott, I.M. (1998) Essential Immunology, ELBS Blackwell Scientific Publications, Oxford
11. Maloy, S.R., Freifelder, D. and Cronan, J.E. (1994) Microbial Genetics, 2nd edn., Jones and Bartlett Publishers
12. Chaudhari Keya (2014) Microbial Genetics, TERI Press, New Delhi ISBN: 9788179933237
13. Abbas A K, Lichtman A H, Pillai S. (2007) Cellular and Molecular Immunology, 6th edition, Saunders Publication, Philadelphia

Proposed methods of teaching/ innovative teaching:
Classroom teaching - lecture method, Group discussion, seminars, moodle, Google Classrooms, audio-visuals (power point presentations), assignments, quiz, etc.

S.Y. B.Sc. (Microbiology): Semester-IV
MB-242: Basic industrial microbiology

Hours: 30 **Credits: 2**

Course objectives:
- To acquaint students with basic concepts of industrial microbiology.
- To infer the upstream and downstream process in fermentation
- To understand the process parameters and types of fermentation

Course outcomes:
After completion of this course students will be able to
- Understand the process of screening important microbes, designing fermentation media.
- Comprehend the basic fermenter design, its accessories and overall fermentation process.
- Be acquainted with diverse downstream processing after fermentation process.

Unit I: Basics of fermentation technology and upstream processing (10 h)
- Characteristics of industrial strains
- Screening of industrially important microorganisms: Primary and Secondary screening examples: vitamin, antibiotic producers
- Concept of strain improvement
- Microbial culture
    - Culture collection centres and their role: National (NCIM) International (ATCC)
    - Preservation of microorganisms: Soil culture, Oil overlay, Liquid nitrogen freezing, Lyophilization
    - Working and stock culture
- Inoculum: characteristics, acclimatization, Inoculum development
- Fermentation media

- Basic composition
- Criteria for selection and screening of media
- Types of media: synthetic, complex and natural
- Major raw materials: Carbohydrates, oils & fats, Corn steep Liquor, Soy meals, Molasses, Sulphite liquors,
- Minor ingredients: growth factors, precursors, buffers, water, antifoam agent
- Sterilization: batch, continuous

Unit II: Fermentation equipments and process **10h**

- Fermenter
  - Criteria for fermenter design
  - Structure of a Typical Fermenter and its parts Impeller, baffles, sparger, stuffing box, etc
  - Measurement and control of fermentation parameters: pH, temperature, dissolved oxygen, foaming and aeration
- Fermentation process
  - Submerged: Batch, Continuous, Fed batch, continuous
  - Solid state fermentation: concept, characteristics and applications
  - Anaerobic versus aerobic fermentation
  - Immobilized cell / enzyme bioreactor
- Example of Fermentation : Alcohol/Beer Production

Unit III: Downstream processing **10h**

Recovery of fermentation products

- Criteria for choice of recovery process
- Cell removal for recovery of product
  - Precipitation
  - Filtration: Theory of filtration, Filter aid, Batch Filter (e.g. Plate & Frame filter), Continuous Filter (e.g. Rotary vacuum filter)
  - Centrifugation: Theory, Basket, Tubular bowl, Multi-chamber
  - Cell aggregation and flocculation
- Cell disruption : Mechanical, Physicaland Chemical methods
- Liquid-Liquid extraction : Co-current and Counter current extraction,
- Distillation : Batch and Continuous

Purification of fermentation products

- Chromatography: Ion exchange, Adsorption, Affinity chromatography
- Membrane process: Ultrafiltration, Reverse Osmosis,

References:

1. Casida, L.E (1998) Industrial Microbiology New Age International Publishers, New Delhi
2. Crueger, W. and Crueger, A. (2000) Biotechnology: A Textbook of Industrial Microbiology, PanimaPubl Co., New Delhi
3. Stanbury, P.F., Whitaker, A. and Halt G. (1995) Principles of Fermentation Technology, Pergamon Press, New York.
4. Whitaker, A. and Stanbury, P.F. (1995) Principles of Fermentation Technology, Butterworth-Heinemann
5. Patel A. H. (1996); Industrial Microbiology McMillan Publication, New Delhi.
6. Prescott S.C and Dunn C.G. (1983) Industrial Microbiology, McGraw Hill Book Co. Inc., New York.

7. Tortora, Funke and Case (2010) Microbiology, Brenjamin Cummings Inc., California
8. Stainer, R.Y., Ingraham, J.L., Wheelis M.L., Painter R.K. (1995) General Microbiology, MacMillan Press Ltd., London.
9. Frobisher M. (1974); Fundamentals of Microbiology, Hinsdill, Crabtree and Goodheart Edition, WB Saunder's Co., USA.
10. Pelczar MJ, Chan ECS, Kneg NR (1998) Microbiology Tata McGraw Hill Publishing Co. Ltd., New Delhi.
11. Singh B. D. (2008) Biotechnology: exploring horizons, Kalyani publishers, Ludhiana
12. Modi H.A., (2009), 'Fermentation Technology', Vol.1 & 2, Pointer publications, India

Proposed methods of teaching/ innovative teaching:
Classroom teaching - lecture method, Group discussion, seminars, moodle, Google Classrooms, audio-visuals (power point presentations), assignments, quiz, etc.

S.Y. B.Sc. (Microbiology): Semester-IV
MB - 243: Practical course based on MB-241 and MB-242

Hours: 60 **Credits: 4**

Course objectives:
- To study internal structural details of bacteria by staining methods
- To understand practical approach for with industrial microbiology
- To study the techniques in analytical and diagnostic microbiology

Course outcomes:
After completion of this course students will be able to
- Describe structure and functions of microbial cell's
- Understand basics of industrial microbiology such as screening of microbes and fermentation
- Detect blood groups and perform cross-matching.
- Infer the diagnostic/ analytical techniques in medical microbiology and industrial products

1. Nucleus staining by any suitable method
2. Volutine granules staining by any suitable method.
3. Isolation of antibiotic resistant mutants by replica plate technique.
4. Estimation of acetic acid from vinegar by titrimetric method.
5. Screening of antibiotic producing microbes by Crowded plate technique and Organic acid producing microbes by Indicator dye method.
6. Cultivation of fungi using solid state fermentation (Plate method)
7. Determination of ABO and Rh blood group and cross matching of blood
8. Total WBC count using haemocytometer from whole blood
9. Demonstration of alcohol production, recovery and determination of alcohol concentration
10. Demonstration of recovery of organic acid from fermentation broth and detection using Paper chromatography / Thin Layer chromatography

11. Demonstration of a typical fermenter
12. Field visit / industrial visit / scientific observation/ scientific model or poster preparation

References:

1. Aneja, K.R. (1996) Experiments in Microbiology, 3rd edition, Wishwa Prakashan, New Delhi.
2. Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York.
3. Dubey, R.C. and Maheshwari D.K. (2004) Practical Microbiology, S. Chand and Co., New Delhi.
4. Harley, J.P. and Prescott, L.M. (1996) Laboratory Exercise in Microbiology, 3rd edn., WCB/McGraw Hill Publ. Co., London
5. Jayaraman, I (1981) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi.
6. Norris, J.R. (1969) Methods in Microbiology Vol. I, 1st edition, Academic Press Inc., London.
7. Parija, S.C. (2007) Textbook of Practical Microbiology, Ahuja Publishing House, New Delhi.
8. Plummer, D.T. (1992) an Introduction to Practical Biochemistry, Tata McGraw Hill Publisher, New Delhi.
9. Sharma, K. (2007) Manual of Microbiology Tools and Techniques, Ane's Book India, New Delhi.

Proposed methods of teaching/ innovative teaching:

Demonstration methods, hands on experiments, virtual labs/e-content available online, Group discussion, audio-visuals (power point presentations)

S.Y. B.Sc. (Microbiology): Semester-IV

MB-240: Food and dairy microbiology

Hours: 30 **Credits: 2**

Course objectives:

- To study the skills in milk and dairy microbiology.
- To understand the various food fermentation process.
- To study the food poisoning and food infections.

Course outcomes:

After completion of this course, students will be able to

- Understand the skills in dairy industry such as milk testing, preservation of milk.
- Acquaint with production process of milk, food products and probiotics .
- Comprehend mechanism of food poisoning and infections.

Unit I: Dairy Microbiology **15h**

- Milk - Definition, Composition and types
- Pasteurization of Milk : Principle and types

- Microbiological examination of milk: Standard plate count, Breed count, Test for mastitis, MBRT test, phosphatase test, Resazurin test, Brucella ring test
- Spoilage of milk: colour and flavour defects, sweet curdling, stormy fermentation ropiness
- Milk products:
    - Fermented milk -Dahi / Yoghurt
    - Cheese: Types, General production process, Ripening and defects
- Concept of probiotics and prebiotics

Unit II: Food Microbiology **15h**

- Food fermentations: Bread, Idli, Vinegar
- Food preservation : Principles and methods
- Microbial Food poisoning with respect to toxins, their effects, properties of toxinsand treatment: *1. Staphylococcus aureus, 2. Bacillus cereus, 3. Clostridium botulinum*
- Food infection: Sources and prevention
    - *Salmonella*
    - *Vibrio parahaemolyticus*
- Aflatoxins: Structure, detection, mode of action and detoxification

References:

1. Adams, M. R., Moss, M. O, (1995) Food Microbiology, New Age International, New Delhi.
2. Banwart, G. J., (1987) Basic Food Microbiology, CBS Publ., New Delhi.
3. Bilgrami, K. S, Dube, H. G., (1994) Text book of Modern Plant pathology, Vikas Publ., New Delhi.
4. Frazier, W. C, Westhoff, D C., (1988) Food Microbiology, Tata McGraw Hill, New Delhi.
5. Winton, A. L, Winton, K. B, (1998) Milk and Milk Products, Agro-botanical Publ, Bikaner.

Proposed methods of teaching/ innovative teaching:

Classroom teaching - lecture method, Group discussion, seminars, moodle, Google Classrooms, audio-visuals (power point presentations), assignments, quiz, etc.

Additional instructions:

- Each theory and practical course will be of 50 marks comprising of 10 marks internal and 40 marks external examination.
- Theory examination (40 marks) will be of two hours duration for each theory course. There shall be 4 questions each earning equal marks (10 marks each). **This pattern may change, as per the guidelines of Board of Examination and Evaluation of college.** The pattern of question papers shall be:
- Question 1 (10 marks): sub-questions, each of 2 marks; answerable in 2 -3 line and based on entire syllabus, attempt any 5 out of 6 questions.
- Question 2, 3 and 4 (10 marks each): based from Unit I, II, and III, respectively, each question has 3 sub-questions of 5 marks each and answers only 2 sub-questions from each Q2, Q3, and Q4 in brief.
- **Internal examination (10 marks each semester):** Internal assessment of the student by respective teacher will be comprehensive and continuous, based on objective/ subjective type questions and as per scheduled by college exam committee.
- **Practical Examination:** Practical examination shall be conducted by the college at the end of the semester. Practical examination will be of minimum 4-5 hours duration and

shall be conducted as per schedule (11 am to 5 pm on schedule date or can be scheduled 10 am -12pm/ 2-4 pm for 2 consecutive days) in case of microbiology practicals where incubation condition, allied aspect are essential. There shall be 5 marks for laboratory log book and well written journal, 5 marks for viva-voce and minimum three experiments (major and minor). Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners (external and internal) per batch for the practical examination.