

SAURASHTRA UNIVERSITY, RAJKOT
SYLLABUS FOR MICROBIOLOGY SEMESTER - VI
(With effect from June 2021)
MB-601: FERMENTATION TECHNOLOGY
(THEORY)

UNIT 1 BASICS OF FERMENTATION TECHNOLOGY & INDUSTRIALLY IMPORTANT MICROORGANISMS
(CREDIT-1.2, TEACHING HOURS-12, MARKS-14)

- 1.1 Basic Concept of fermentation technology & historical development of industrial microbiology
- 1.2 Range of Fermentation Processes & its Component parts
- 1.3 Primary & Secondary Screening of industrial important microbes & culture collection centre
- 1.4 Isolation & improvements of industrial important microbes
- 1.5 Fermentation economics

REFERENCE BOOKS

1. Principles of Fermentation Technology by Stanbury & Whittaker. 2nd edition. Butterworth-Heinemann, Elsevier Ltd.
2. Industrial Microbiology by L. E. Casida. 2nd edition. New Age International Private Limited
3. A text book of Industrial Microbiology by Wulf Crueger & Anneliese Crueger. 2nd edition. Sinauer Associates Inc., U.S.
4. Industrial Microbiology by A.H. Patel. 2nd edition. Laxmi Publications
5. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology vol. 1 & 2 by V.K. Joshi & Ashok Pandey. Asiatech Publishers Inc.

UNIT 2 FORMULATION OF FERMENTATION MEDIA
(CREDIT-1.2, TEACHING HOURS-12, MARKS-14)

- 2.1 Introduction to Media and its Types
- 2.2 Media formulation
- 2.3 Raw materials: Crude Carbon and Nitrogen sources, Minerals, Precursors, Growth Regulators, Buffers, Antifoam agents
- 2.4 Inoculum and Production medium
- 2.5 Media Optimization

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1. Principles of Fermentation Technology by Stanbury & Whittaker. 2nd edition. Butterworth-Heinemann, Elsevier Ltd.
2. Industrial Microbiology by L. E. Casida. 2nd edition. New Age International Private Limited

3. A text book of Industrial Microbiology by WulfCruieger&AnnelieseCruieger. 2ndedition. Sinauer Associates Inc.,U.S.
4. Industrial Microbiology by A.H. Patel. 2nd edition. Laxmi Publications
5. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology vol. 1 & 2 by V.K. Joshi & Ashok Pandey. Asiatech Publishers Inc.

UNIT 3 DESIGN AND ASEPTIC OPERATION (CREDIT-1.2, TEACHING HOURS-12, MARKS-14)

- 3.1 Introduction and basic functions of fermenter: criteria and design
- 3.2 Types of bioreactors
- 3.3 Aeration and Agitation – Types and importance of agitators & aerators
- 3.4 Sterilization process in fermentation industries: Introduction of Del factor, an overview of Fermentor sterilization & Medium sterilization
- 3.5 Fermentation process: Batch Fermentation, Continuous fermentation and their comparative advantages and disadvantages

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1. Principles of Fermentation Technology by Stanbury& Whittaker. 2nd edition. Butterworth-Heinemann, Elsevier Ltd.
2. A text book of Industrial Microbiology by WulfCruieger&AnnelieseCruieger. 2nd edition. Sinauer Associates Inc.,U.S.
3. Industrial Microbiology by A.H. Patel. 2nd edition. Laxmi Publications

UNIT 4 OVERVIEW: DOWNSTREAM PROCESSES (CREDIT-1.2, TEACHING HOURS-12, MARKS-14)

- 4.1 Methods of Cell separation: Broth conditioning, Precipitation, Sedimentation, Centrifugation, Filtration
- 4.2 Centrifugation and filtration
- 4.3 Techniques of Cell Disruption: Mechanical and Non mechanical methods
- 4.4 Product Recovery: Liquid liquid extraction, Solvent recovery, Two Phase aqueous extraction, Super critical fluid extraction
- 4.5 Physical, Chemical and Biological assay of fermentation products

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1. Principles of Fermentation Technology by Stanbury& Whittaker. 2ndedition. Butterworth-Heinemann, Elsevier Ltd.
2. Industrial Microbiology by L. E. Casida. 2nd edition. New Age International Private Limited

3. A text book of Industrial Microbiology by WulfCrueger&AnnelieseCrueger. 2nd edition. Sinauer Associates Inc.,U.S.
4. Industrial Microbiology by A.H. Patel. 2nd edition. Laxmi Publications

UNIT 5 STUDIES OF SELECTIVE FERMENTATION PROCESSES
(CREDIT-1.2, TEACHING HOURS-12, MARKS-14)

- 5.1 Production of organic solvents: Ethyl alcohol
- 5.2 Production of enzymes & vitamins: Amylases and Riboflavin
- 5.3 Production of antibiotics: Penicillin
- 5.4 Production of amino acids & organic acids: Lysine and Citric acid
- 5.5 Introduction to methods of immobilizations – Whole cell and/or enzyme: Applications of immobilization

REFERENCE BOOKS

1. Industrial Microbiology by L. E. Casida. 2nd edition. New Age International Private Limited
2. A text book of Industrial Microbiology by WulfCrueger&AnnelieseCrueger. 2nd edition. Sinauer Associates Inc.,U.S.
3. Industrial Microbiology by A.H. Patel. 2nd edition. Laxmi Publications
4. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology vol. 1 & 2 by V.K. Joshi & Ashok Pandey. Asiatech Publishers Inc.
5. Trevan, M.D., et al., Biotechnology -The Biological Principles. Tata Mcgraw Hill Publishing Co Ltd.

SYLLABUS FOR MICROBIOLOGY SEMESTER - VI

(With effect from June 2021)

MB-601: FERMENTATION TECHNOLOGY

(PRACTICAL)

- 1 Primary screening of industrially important microorganisms capable of producing: Antibiotics, Organic acids, amylases
- 2 Bioassay of streptomycin using *E.coli*.
- 3 Laboratory fermentation & estimation of Ethyl Alcohol by *Saccharomyces*
- 4 Laboratory fermentation & estimation of amylase by *Bacillus spp.*
- 5 Sterility testing of fermentation products (Demo)
- 6 Immobilization of yeast cells by Ca- alginate entrapment method & Determination of viability of immobilized cells by invertase activity

REFERENCE BOOKS

1. Microbiology- A laboratory Manual by James G. Chappuccino & Natalie Sherman. 4th edition. Pearson Benjamin Cummings
- 2 Handbook Bacteriological Techniques by F.J. Baker. 2nd edition. Butterworth & Co Publishers Ltd.
- 3 Introduction to Microbial Techniques By Gunasekaran
- 4 Experimental Microbiology (volume 1 &2) by Rakesh Patel. 3rd Edition. Aditya Publishers.

SAURASHTRA UNIVERSITY, RAJKOT

SYLLABUS FOR MICROBIOLOGY SEMESTER - VI
(With effect from June 2021)
MB 602: BIO-ANALYTICAL TECHNIQUES
(THEORY)

UNIT 1: Basic Analytical Techniques in Biosciences
(Credit-1.2, Teaching Hours-12, Marks-14)

- 1.1 Concept Of Good Laboratory Practices and Quality Management
- 1.2 Applications of Radioisotopes in Biosciences

Principle, Instrumentation and applications of following spectroscopy techniques:

- 1.3 Colorimetry and UV- Visible Spectrophotometry
- 1.4 Mass spectroscopy, IR spectroscopy and NMR spectroscopy
- 1.5 Atomic Spectroscopy: Atomic Absorption/Emission Spectrometer

REFERENCE BOOKS

- 1. Purohit, S. S. (2012). Microbiology: Fundamentals and applications. Jodhpur: Agrobios (India).
- 2. Wilson, K., Walker, J. M., Hofmann, A., & Clokie, S. (2018). Wilson and Walker's principles and techniques of biochemistry and molecular biology.
- 3. Srivastava, M. (2008). Bioanalytical techniques. Oxford: Alpha Science International.
- 4. Ramesh, V. (2019). Biomolecular and Bioanalytical Techniques: Theory, Methodology and Applications.
- 5. Upadhyay, A., Upadhyay, K., & Nath, N. (2009). Biophysical chemistry: (principles and techniques). Himalaya Pub. House Mumbai, India.

Unit 2: Principles and Theories of Chromatography
(Credit-1.2, Teaching Hours-12, Marks-14)

- 2.1 Introduction to Chromatography – Partition & adsorption; planner & column
- Principle, working and applications of following chromatography techniques**
- 2.2 Paper and Thin Layer Chromatography
 - 2.2 Affinity and Ion Exchange Chromatography
 - 2.3 Size Exclusion Chromatography and Gas Chromatography
 - 2.4 High Performance Liquid Chromatography (HPLC) and FPLC
 - 2.5 Concept and applications of GC-MS and LC-MS

REFERENCE BOOKS

- 1. Purohit, S. S. (2012). Microbiology: Fundamentals and applications. Jodhpur: Agrobios (India).
- 2. Wilson, K., Walker, J. M., Hofmann, A., & Clokie, S. (2018). Wilson and Walker's principles and techniques of biochemistry and molecular biology.

3. Srivastava, M. (2008). Bioanalytical techniques. Oxford: Alpha Science International.
4. Ramesh, V. (2019). Biomolecular and Bioanalytical Techniques: Theory, Methodology and Applications.
5. Upadhyay, A., Upadhyay, K., & Nath, N. (2009). Biophysical chemistry: (principles and techniques). Himalaya Pub. House Mumbai, India.

Unit 3: Molecular Techniques and Biosensor Technology **(Credit-1.2, Teaching Hours-12, Marks-14)**

- 3.1 Electrophoresis: Basic principle, components and applications of Paper electrophoresis & Agarose gel electrophoresis
- 3.2 PFGE: Principle, working and applications of Native gel electrophoresis & SDS-PAGE
- 3.3 An overview of 2D-PAGEs (concept of isoelectric focusing) & Capillary electrophoresis
- 3.4 Introduction to Autoradiography & Flow cytometry
- 3.5 Overview of Biosensor Technology

REFERENCE BOOKS

1. Purohit, S. S. (2012). Microbiology: Fundamentals and applications. Jodhpur: Agrobios (India).
2. Wilson, K., Walker, J. M., Hofmann, A., & Clokie, S. (2018). Wilson and Walker's principles and techniques of biochemistry and molecular biology.
3. Srivastava, M. (2008). Bioanalytical techniques. Oxford: Alpha Science International.
4. Ramesh, V. (2019). Biomolecular and Bioanalytical Techniques: Theory, Methodology and Applications.
5. Upadhyay, A., Upadhyay, K., & Nath, N. (2009). Biophysical chemistry: (principles and techniques). Himalaya Pub. House Mumbai, India.

Unit 4. Modern Bioanalytical Techniques **(Credit-1.2, Teaching Hours-12, Marks-14)**

- 4.1 DNA sequencing: Principles and Methods, Automated DNA sequence Analyzer
- 4.2 Blotting techniques and FISH
- 4.3 RFLP, RAPD, VNTR, STR and SNP analysis
- 4.4 Chemical synthesis of DNA
- 4.5 PCR Technology: Principle, Methods, Primer design (overview and Features) and Applications.

REFERENCE BOOKS

1. Purohit, S. S. (2012). Microbiology: Fundamentals and applications. Jodhpur: Agrobios (India).
2. Wilson, K., Walker, J. M., Hofmann, A., & Clokie, S. (2018). Wilson and Walker's principles and techniques of biochemistry and molecular biology.
3. Srivastava, M. (2008). Bioanalytical techniques. Oxford: Alpha Science International.
4. Ramesh, V. (2019). Biomolecular and Bioanalytical Techniques: Theory, Methodology and

Applications.

5. Upadhyay, A., Upadhyay, K., & Nath, N. (2009). Biophysical chemistry: (principles and techniques). Himalaya Pub. House Mumbai, India.
6. Trevan, M.D., et al., Biotechnology -The Biological Principles. Tata Mcgraw Hill Publishing Co Ltd.
7. Twyman R. M., Advanced Molecular Biology – 1st Edition. Taylor & Francis Group. UK.
8. Malacinski G. M. & David Freifelder, Essential of Molecular Biology – 3rd Edition. Boston: Jones and Bartlett Publishers, c1998.
9. T. A. Brown, Gene Cloning and DNA Analysis: An Introduction -7th Edition. Wiley-Blackwell publications.
10. Sandy B. Primrose, Richard Twyman & Bob Old, Principles of Gene Manipulation – 6th Edition. Wiley-Blackwell publications

Unit 5: Bioinformatics

(Credit-1.2, Teaching Hours-12, Marks-14)

5.1 Introduction and Importance of Bioinformatics

5.2 Database and DBMS: Primary and Secondary Biological Databases, Structure Databases, Miscellaneous Database

5.3 Information Retrieval from Biological Database: ENTREZ, SRS and DBGET

5.4 Sequence Alignment tools: BLAST and FASTA

5.5 Construction of Phylogenetic tree using computer

REFERENCE BOOKS

1. Hodgman, T. C., French, A., & Westhead, D. R. (2010). Bioinformatics. Abingdon: Taylor & Francis.
2. Attwood, T. K., & Parry-Smith, D. J. (1998). Introduction to bioinformatics. Harlow. Pearson.
3. Baxevanis, A. D., & Ouellette, B. F. F. (2001). Bioinformatics: A practical guide to the analysis of genes and proteins. Wiley Intersciences, New York.

SYLLABUS FOR MICROBIOLOGY SEMESTER - VI
(With effect from June 2021)
MB-602: Bio-Analytical Techniques
(PRACTICAL)

1. Determination of absorbance maxima of KMnO_4
2. Separation of carbohydrates / amino acids by ascending paper chromatography.
3. Separation of amino acids by circular paper chromatography.
4. Separation of amino acids by Thin layer chromatography.
5. Separation of nucleic acid by agarose gel electrophoresis.
6. Separation of proteins by SDS PAGE (Demonstration).
7. Retrieval of DNA/gene sequence of bacterial species from NCBI.
8. Demonstration of BLAST analysis.

REFERENCE BOOKS

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi
4. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane Books, Delhi

SYLLABUS FOR MICROBIOLOGY SEMESTER - VI

(With effect from June 2021)

MB-603: CLINICAL DIAGNOSTIC MICROBIOLOGY

(THEORY)

Unit1: Hematology

(Credit-1.2, Teaching Hours-12, Marks-14)

- 1.1. Hematopoiesis
- 1.2. Discovery of human blood group system, ABO and Rh system
- 1.3. Hemostasis
- 1.4. Introduction to blood banking & Separation and storage of blood components
- 1.5. Principle, significance and procedure of blood transfusion

REFERENCE BOOKS

1. Michael, J. P. (2009). Microbiology: An Application Based Approach. Tata McGraw Hill Education Private Limited.
2. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2003). Immunology. 7th -12th edition. W. H.
3. Atlas, R. M. (1997). Principles of microbiology. 2nd edition. Dubuque, IA: Wm. C. Brown Publishers.
4. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). Prescott, Harley, and Klein's microbiology. 7th -12th edition. New York: McGraw-Hill Higher Education.
5. Ananthanarayan, R. (2013). Textbook of microbiology. Hyderabad: University Press (India).
6. Mukherjee, K. L., & Ghosh, S. (2010). Medical laboratory technology: Procedure manual for routine diagnostic tests (vol 1 to 3). New Delhi: Tata McGraw Hill.

Unit 2: Serology

(Credit-1.2, Teaching Hours-12, Marks-14)

- 2.1 In vitro antigen: antibody reaction: Precipitin test (in fluid and gel) and Complement fixation test.
- 2.2 Agglutination test (Hemagglutination, Bacterial Agglutination, Passive Agglutination and agglutination inhibition)
- 2.3 Special Serological tests: Fluorescent antibody technique, Neufeld-Quellung reaction, Detection of heterophile antibody and Virus neutralizing antibody.
- 2.4 Evaluation of Virulence: Antifibrinolysin & Antistreptolysin.
- 2.5 Overview of Intracutaneous diagnostic test

REFERENCE BOOKS

1. Michael, J. P. (2009). Microbiology: An Application Based Approach. Tata McGraw Hill Education Private Limited.
2. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2003). Immunology. 7th -12th edition. W. H.
3. Atlas, R. M. (1997). Principles of microbiology. 2nd edition. Dubuque, IA: Wm. C. Brown Publishers.

4. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). Prescott, Harley, and Klein's microbiology. 7th -12th edition. New York: McGraw-Hill Higher Education.
5. Ananthanarayan, R. (2013). Textbook of microbiology. Hyderabad: University Press (India).
6. Mukherjee, K. L., & Ghosh, S. (2010). Medical laboratory technology: Procedure manual for routine diagnostic tests (vol 1 to 3). New Delhi: Tata McGraw Hill.

Unit 3: Conventional and Advanced Diagnostic Techniques (Credit-1.2, Teaching Hours-12, Marks-14)

A. Conventional techniques.

3.1 Methods of specimen collection.

3.2 Identification of microbes from specimen: Microscopy, Rapid methods of identification and Molecular methods.

B. Advanced techniques.

3.3 Immuno-electrophoresis and Immunofluorescence.

3.4 Radioimmunoassay, ELISA, Western Blot.

3.5 Detection of pathogen by PCR, Immunohistochemistry and Immunotherapy.

REFERENCE BOOKS

1. MICHAEL, J. P. (2009). Microbiology: An Application Based Approach. Tata McGraw Hill Education Private Limited.
2. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2003). Immunology. 7th -12th edition. W. H.
3. Atlas, R. M. (1997). Principles of microbiology. 2nd edition. Dubuque, IA: Wm. C. Brown Publishers.
4. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). Prescott, Harley, and Klein's microbiology. 7th -12th edition. New York: McGraw-Hill Higher Education.
5. Ananthanarayan, R. (2013). Textbook of microbiology. Hyderabad: University Press (India).
6. Mukherjee, K. L., & Ghosh, S. (2010). Medical laboratory technology: Procedure manual for routine diagnostic tests (vol 1 to 3). New Delhi: Tata McGraw Hill.
7. Dey NC, Dey TK, Sinha D. Medical Bacteriology Including Medical Mycology and AIDS; New Central Book Agency, Kolkata.
8. Lydyard, P., Whelan, A., & Fanger, M. (2011). BIOS Instant Notes in Immunology. 2nd edition. Hoboken: Taylor and Francis.
9. S. C. Parija. (2012). Textbook of Microbiology and Immunology. 2nd edition. Reed Elsevier India Private Limited

Unit 4: Epidemiology and Microbial Agents of Disease (Bacteria & Fungi)

(Credit-1.2, Teaching Hours-12, Marks-14)

4.1 Epidemiology of infectious disease: Markers, concepts and tools

Bacteria – Pathogenicity, diagnosis, treatment and prevention

4.2 Gram negative Bacteria– *Treponema and Salmonella*

4.3 Gram positive Bacteria – *Streptococci and Mycobacterium*

Fungi - Pathogenicity, diagnosis, treatment and prevention

4.4 *Malassezia furfur, Tineapedis and Sporotrichum schenckii*

4.5 *Cryptococcus neoformans* and *Candida albicans*

REFERENCE BOOKS

1. MICHAEL, J. P. (2009). Microbiology: An Application Based Approach. Tata McGraw Hill Education Private Limited.
2. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2003). Immunology. 7th -12th edition. W. H.
3. Atlas, R. M. (1997). Principles of microbiology. 2nd edition. Dubuque, IA: Wm. C. Brown Publishers.
4. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). Prescott, Harley, and Klein's microbiology. 7th -12th edition. New York: McGraw-Hill Higher Education.
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6. Mukherjee, K. L., & Ghosh, S. (2010). Medical laboratory technology: Procedure manual for routine diagnostic tests (vol 1 to 3). New Delhi: Tata McGraw Hill.
7. Dey NC, Dey TK, Sinha D. Medical Bacteriology Including Medical Mycology and AIDS; New Central Book Agency, Kolkata.
8. Lydyard, P., Whelan, A., & Fanger, M. (2011). BIOS Instant Notes in Immunology. 2nd edition. Hoboken: Taylor and Francis.
9. S. C. Parija. (2012). Textbook of Microbiology and Immunology. 2nd edition. Reed Elsevier India Private Limited

Unit 5:. Microbial Agents of Disease (Protozoa and Virus), and Prophylaxis

(Credit-1.2, Teaching Hours-12, Marks-14)

5.1 Protozoa: Pathogenicity, diagnosis, treatment and prevention of *Plasmodium spp.* & *Entamoeba histolytica*

Viruses – - Pathogenicity, diagnosis, treatment and prevention.

5.2 Air borne infections: Influenza & Mumps.

5.3 Food-Water borne infection: Hepatitis virus & Rota virus.

5.4 Viral Zoonosis: Rabies virus & Swine Flu.

5.5 Direct contact: HIV & Herpes virus.

REFERENCE BOOKS

1. MICHAEL, J. P. (2009). Microbiology: An Application Based Approach. Tata McGraw Hill Education Private Limited.
2. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2003). Immunology. 7th -12th edition. W. H.
3. Atlas, R. M. (1997). Principles of microbiology. 2nd edition. Dubuque, IA: Wm. C. Brown Publishers.
4. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). Prescott, Harley, and Klein's microbiology. 7th -12th edition. New York: McGraw-Hill Higher Education.
5. Ananthanarayan, R. (2013). Textbook of microbiology. Hyderabad: University Press (India).
6. Mukherjee, K. L., & Ghosh, S. (2010). Medical laboratory technology: Procedure manual for routine diagnostic tests (vol 1 to 3). New Delhi: Tata McGraw Hill.
7. Dey NC, Dey TK, Sinha D. Medical Bacteriology Including Medical Mycology and AIDS; New Central Book Agency, Kolkata.
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(With effect from June 2021)

MB-603: CLINICAL DIAGNOSTIC MICROBIOLOGY

(PRACTICAL)

1. Antibiotic susceptibility of the pathogens isolated from the clinical specimen
2. Study of Agglutination by
 - a. Blood grouping
 - b. Serodiagnosis of enteric fever by Widal test
 - c. Serodiagnosis of syphilis by RPR Test
3. Haemoglobin estimation by Sahli's method
4. Bleeding time by filter paper technique and clotting time by capillary method
5. Erythrocyte Sedimentation Rate (ESR-demonstration)
6. Blood sugar estimation by GOD / POD method
7. Determination of Serum bilirubin
8. Determination of Serum Cholesterol
9. Physical, chemical and microscopic analysis of urine
10. Screening of Thalassemia by NESTROFT
11. Total count of platelets

REFERENCE BOOKS

1. Talwar, G. P., & Gupta, S. K. (1992). A Handbook of Practical and Clinical Immunology. New Delhi: CBS Publishers & Distributors.
2. Medical Laboratory Technology – Vol – I, II, III – Mukherji K.L. 2nd edition. Tata McGraw-Hill Education.
3. Godkar, P. B., & Godkar, P. D. (2005). Text Book of Medical Laboratory Technology: Basic Histopathologic Techniques and the Laboratory Requirements. Bhalani Publishing House.
4. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India
5. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India