



CIRCULAR NO.SU/B.Sc./CBC&GS /69/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies, Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc. Biotechnology (Optional)	IIIrd & IVth semester
2.	B.Sc. Microbiology (Optional)	IIIrd & IVth semester
3.	B.Sc. Information Technology (Optional)	IIIrd & IVth semester
4.	Bachelor of Computer Application (Optional)	IIIrd & IVth semester
5.	B.Sc.Polymer Chemistry (Optional)	IIIrd & IVth semester
6.	B.Sc.Computer Science (Degree)	IIIrd & IVth semester
7.	Honors Degree of Computer Science	IIIrd & IVth semester
8.	Honors Degree of Biotechnology	IIIrd & IVth semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.

REF.NO.SU/2023/ 1241-49

Date:- 12.06.2023.

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*Deputy Registrar,
Academic Section*

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.**
- 2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
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**Dr. Babasaheb Ambedkar Marathwada University
Aurangabad – 431 004 (MS) India**



Curriculum

B. Sc. II year Microbiology

Semester III and IV

Course Structure and Curriculum

Choice Based Credit System & Grading System (CBCS & GS)

(Effective from Academic Year 2023-24)

**Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad**

**Chairman
Board of Studies in
Microbiology**

Course structure of B.Sc. II (Microbiology optional subject)
(Choice Based Credit System)

Semester III (Core Courses and Skill Enhancement Courses)

	Course	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Option I (DSC 1C) Core Courses	MCB-311	Environmental Microbiology	45 (3/week)	2	50	10	40	20
	MCB-312	Immunology and Clinical Microbiology	45 (3/week)	2	50	10	40	20
	MCB-321	Lab course 3 (based on MCB-311)	45 (3/week)	1.5	50	10	40	20
	MCB-322	Lab course 4 (based on MCB-312)	45 (3/week)	1.5	50	10	40	20
Skill enhancem ent course (SEC-1)	MB - 313	SEC 1: Instrumentation & Biotechniques [#]	45 (3/week)	2	50	10	40	20
	MB - 314	SEC 1: Quality Control in Food & Pharmaceutical Industries [#]	45 (3/week)	2	50	10	40	20
Ability enhancem ent compulsor y course (AECC-3)	ENG-331	Communication Skills in English III	45 (5/week)	3	50	10	40	20
	SL-332	Marathi/Hindi/Urdu/Sanskrit A student can opt for anyone of these Language (SL-III)	45 (4/week)	3	50	10	40	20
			315	15	350	70	280	140

Total credits for Semester III: 15 (Theory: 12; Laboratory: 03)

Semester IV (Core Courses and Skill Enhancement Courses)

	Course	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Option I (DSC 1D) Core Courses	MCB-411	Food and Dairy Microbiology	45 (3/week)	2	50	10	40	20
	MCB-412	Microbial Physiology	45 (3/week)	2	50	10	40	20
	MCB-421	Lab course 5 (based on MCB-411)	45 (3/week)	1.5	50	10	40	20
	MCB-422	Lab course 6 (based on MCB-412)	45 (3/week)	1.5	50	10	40	20
Skill enhancem ent course (SEC-2)	MB - 413	SEC-2: Quality Control in Food & Pharmaceutical Industries [#]	45 (3/week)	2	50	10	40	20
	MB - 414	SEC-2: Instrumentation & Biotechniques [#]	45 (3/week)	2	50	10	40	20
Ability enhancem ent compulsor y course (AECC-4)	ENG-431	Communication Skills in English IV	45 (5/week)	3	50	10	40	20
	SL-332	Marathi/Hindi/Urdu/Sanskrit A student can opt for anyone of these Language (SL-III)	45 (4/week)	3	50	10	40	20
Additional Credits		Environmental Studies	45 (3/week)	2*	50	10	40	20
			315	15	350	70	280	140

Total credits for Semester III: 15 (Theory: 12; Laboratory: 03)

Important note: [#] SEC opted for III Semester cannot be repeated in IV Semester

B.Sc. Second Year
[Microbiology] Semester III
Paper MCB-311 Environmental Microbiology

Unit 1: Microbiology of air: (10)

- i. Composition of air.
- ii. Number and kinds of microorganisms in air (indoor outdoor Distribution and sources of our borne microorganisms.
- iii. Air as a carrier of microorganisms
- iv. Droplet, droplet nuclei, Dispersal of Microorganisms in air. Techniques for microbiological analysis of air.
- v. Significance of air flora in human health, hospitals, industries.
- vi. Air sanitation- dust control, UV radiation, bactericidal vapors, filtration, Laminar airflow system (HEPA filters)

Unit 2. Microbiology of Water and Wastewater: (10)

- i. Sources of microbes in water.
- ii. Determining sanitary quality of water indicators of fecal pollution: Fecal and non-fecal coliforms (IMVIC & elevated temperature tests).
- iii. Bacteriological examination of water: Presumptive, confirmed, completed test, SPC, MPN and Membrane filter technique.
- iv. Water purification methods: Disinfection of potable water supplies. Definition of sewage and chemical composition.
- v. Microbiology of sewage treatment: septic tank, evapotranspiration, Imhoff's tank Municipal sewage treatment process: Primary, Secondary, (aerobic and anaerobic process), chemical treatment chlorination.
- vi. Disposal of treated sewage. (Sludge as fertilizer, imigation and dilution)

Unit 3. Microbiology of Soil: (10)

- i. Soil as an environment, as a culture medium.
- ii. Brief account and definition of microbial interactions with examples.
- iii. Symbiosis, mutualism, commensalism, competition, synergism, satellitism, predation, parasitism with example:
 1. Microbe-microbe interactions (any one example)
 2. Plant-microbe interactions (Phyllosphere)
 3. Animal-microbe interactions [Rumen, Bioluminescence]
- iv. Major biogeochemical cycles: Carbon nitrogen, phosphorus, sulphur (cyclic turn over with microbiology). General account of microbes used as biofertilizers, phosphate solubilizers.
- v. (Definition, Types, advantages, disadvantages) Rhizosphere: definition, rhizosphere and non-rhizosphere microflora and R:S ratio, significance for fertility.

Unit 4. Environmental Pollution (10)

- Air pollution sources, causes, health hazards, airborne diseases any 5 (list of causative

agents).

- Water pollution: sources, causes, health hazards, waterborne diseases any 5 (list of causative agents).
- Wastewater pollution: sources, causes, health hazards, Eutrophication and Acid mine drainage: basic concept.
- Soil: sources, causes, health hazards.

Unit 5: Tutorials, Seminars and Assignments

(05)

**B.Sc. Second Year
MICROBIOLOGY
Lab Course-3 MCB-321**

1. Enumeration of microbes from: Indoor and outdoor environment.
2. Bacteriological examination of drinking water: MPN, SPC
3. Qualitative analysis of water: Presumptive, Confirmed, Completed test.
4. Demonstration of Automated water testing methods (The growth direct by Rapid micro biosystem, Bioburden testing)
5. Dust Fall Jar: Construction and analysis of pollution trend in the selected area.
6. Collection of Data from Internet: Respiratory suspended particulate matter (RSPM) in various metro cities in India
7. Fabrication: Fabricate Sedimentation Tank in the laboratory.
8. Testing of (water & domestic sewage) for physicochemical parameters like chlorine, phosphate, nitrate, BOD, and COD, TS, TDS, TSS.
9. Isolation of *E. coli* and identification by IMVIC
10. Isolation of coliphages from sewage
11. Isolation enteric pathogens from domestic sewage (*Salmonella* and *Shigella* spp.)

B.Sc. Second Year Microbiology
Semester III
Paper MCB-312 Immunology and Clinical Microbiology

Unit – 1. Normal flora and Immunity

(10)

- i. Normal flora of human body and its significance
- ii. Definition and classification: Innate / Acquired, Barriers and types with examples. Cellular/Humoral immunity, Humoral factors of immunity: complement, interferon.
- iii. Antigens (Immunogens): Definition, determinant's of antigenicity, a) size, b) chemical, c) nature, d) susceptibility to tissue enzymes, foreignness, specificity of antigens. Types of antigens: species specific antigen, Isoantigen, autoantigen, organ specific antigen, MHC antigen, Heterogenetic (Heterophile) antigen, antigens in relation to bacterial cell.
- iv. Antibodies (Immunoglobulins): Structure, classes and functions, Types of antibodies: antitoxin, precipitin, agglutinin, bacteriolysin, bacteriocidin, bacteriotropin, complement fixing, neutralizing.
- v. Hybridoma Technology and Monoclonal Antibodies

Unit – 2. Immune system, Antigen – Antibody reactions, Vaccines and hypersensitivity (10)

- i. Immune system: organs and cells involved and functions, types of cells their differentiation and functions.
- ii. General features, Mechanisms, methods & applications of Antigen- Antibody reactions
 - Precipitation.
 - Agglutination.
 - Complement fixation.
 - Neutralization.
 - Immunofluorescence.
 - ELISA.
- iii. Vaccines and toxoids: Types of vaccines, various methods involved in production of BCG, TAB, OPV, T.T., DPT, Covid-19 vaccines.
- iv. Hypersensitivity: Four types with one example (in brief).
- v. Autoimmunity and Autoimmune diseases: Myasthenia gravis and Rheumatoid arthritis (in brief).

Unit – 3. Study of Human Diseases caused by bacteria

(10)

Study of following diseases w. r. t. morphology, classification, staining reactions, cultural & biochemical characters, antigenic structure, pathogenesis, Laboratory diagnosis, epidemiology, prophylaxis and chemotherapy.

- i. *Staphylococcus aureus*
- ii. *Mycobacterium tuberculosis*
- iii. *Salmonella typhi*
- iv. *Streptococcus pneumoniae*
- v. *Neisseria gonorrhoeae*

Unit – 4. Study of Human Diseases caused by fungi, protozoa and viruses (10)

- i. Fungal diseases - Candidiasis
- ii. Protozoal diseases – Malaria (Life cycle)
- iii. Viral diseases – HIV, Hepatitis A, Covid-19, Chikungunya (structure of virus, steps involved in disease production, pathogenesis, laboratory diagnosis, prophylaxis and treatment)

Unit – 5 Tutorials, Seminars and Assignments (05)

Lab Course - 4 MCB 322

1. Isolation & study of normal flora of skin/ nose/ throat.
2. Precipitation test: Demonstration.
 - I. Single radial immunodiffusion
 - II. Immuno electrophoresis.
3. Agglutination tests: (Slide tests)
 - I. Blood grouping
 - II. Widal test
 - III. RA factor test
4. Staining techniques
 - I. Acid fast staining
 - II. Blood staining (differential WBC count)
 - III. Malarial parasites staining (Demonstration using permanent slide only).
5. Rapid *Test Kit* chromatographic immunoassay tests: Dengue, Chikungunya, malaria, Covid, HIV, HCV, HBsAg (Any two tests).
6. Demonstration of media for cultivation of pathogenic bacteria
 - I. Mannitol salt agar.
 - II. Wilson and Blair's medium
 - III. Lowenstein- Jenson's medium
 - IV. Sabouraud Dextrose Agar (SDA)
7. Study bacterial pathogens:
 - i. *Staphylococcus aureus*
 - ii. *Salmonella typhi*
 - iii. *Candida albicans* (Germ tube test).
8. Demonstration of hemolysin & coagulase tests.
9. Determination of antibiotic resistance of bacteria.

References

1. A Textbook of Microbiology. Chakraborty P. (2013). 3rd edition. New Central Book Agency. India. ISBN-13: 978-8173818769.
2. Medical Bacteriology Including Medical Mycology and AIDS. Dey N. C., Dey T. K. and Sinha D. (2013). 17th Edition. New Central Book Agency (P) Ltd (Publisher). India.
3. Textbook of Microbiology. Kanungo Reba. (2017). Ananthanarayan and Paniker's 10th edition. The Orient Blackswan Publisher. ISBN-13: 978-9386235251.
4. Microbiology: An introduction. Tortora G. J., Funke B. R. and Case C. L. (2016). 12th Edition, Pearson. ISBN-13: 9780321929150.
5. Medical Microbiology and Immunology. Goering R., Dockrell H., Zuckerman M., Roitt I. and Chiodini P. L. (2018). Mims' 6th Edition. Elsevier. ISBN: 9780702071546.
6. Basic Immunology- Functions and Disorders of Immune System. Abbas A. K. and Lichtman A. H. (2004). 2nd Ed. Saunders. Elsevier Inc. PA. USA.
7. Immunology. Kubly J. (1996) 3rd Ed. W. H. Freeman and Co, New York.
8. Essentials of Immunology. Roitt M. (1984). P. G. Publishers Pvt. Ltd., New Delhi.
9. Handbook of Immunology, Talwar G. P. (1983). Vikas Publishing Pvt. Ltd. New Delhi.
10. Immunology - Essential and Fundamental. Pathak S. S. and Palan V. (1997) Preen Publications Bombay.
11. Medical virology 10th edition by Morag C and Timbury M C 1994. Churchill Livingstone, London.
12. Basic Virology, Edward K. Wagner, Martinez J. Hewlett, 3rd edition, Blackwell publication.
13. Introduction to modern virology. 4th Edition by Dimmock N J, Primrose S. B. 1994. Blackwell scientific publications. Oxford.
14. Textbook on Principles of Bacteriology, Virology and Immunology, Topley and Wilson 1995.
15. Virology: principles and applications by John Carter and Venetia Saunders.

MB-313 Skill Enhancement Elective Courses -1
Instrumentation & Biotechniques

Credits: 2

Total hours: 30

Theory: Credit: 1

Total Hours: 15

Unit 1 Chromatography

(4)

Principles and applications of paper chromatography, Column packing and fraction collection. Gel filtration chromatography, ion- exchange chromatography and affinity chromatography, GLC, HPLC, GCMS, LCMS & (Introduction & Application)

Unit 2 Electrophoresis

(4)

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 3 Spectrophotometry

(4)

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry. Introduction & Application of MSMS

Unit 4 Centrifugation

(3)

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

Practical Credit: 1

Total Hours: 15 (3 hours for each practical) Any 5

1. Preparation of column for Column chromatography, Preparation of eluents & Techniques of elution
2. Separation of mixtures by paper / thin layer chromatography
3. Study of GCMS & LCMS peak patterns Any 2
4. Electrophoretic separation of serum proteins by PAGE
5. Study of absorption spectra of any two biomolecules
6. Separation of DNA by centrifugation
7. Understanding density gradient centrifugation with the help of pictures
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Visit to Central Instrumentation facility Centre

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

MB-314 Skill Enhancement Elective Courses - 1
Quality Control in Food & Pharmaceutical Industries

Credits: 2

Total hours: 30

Theory: Credit: 1

Total Hours: 15

Unit 1 Microbiological Laboratory and Safe Practices

(4)

Good laboratory practices - Good laboratory practices, Good microbiological practices Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

Unit 2 Determining Microbes Pharmaceutical Samples

(3)

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water

(6)

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Food Safety and Microbial Standards

(2)

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

Practical Credit: 1

Total Hours: 15 (3 hours for each practical) Any 5

1. Methods of disinfection , autoclaving & incineration
2. Demonstration of PCR
3. Sterility testing of pharmaceutical product (Any 1)
4. Isolation of pathogen from food sample (Any 1 pathogen from one food sample)
5. Microbial quality of milk by MBRT
6. Microbial quality of milk by 10 Min Resazurin assay
7. Study of BIS standards of common foods (Any 2)
8. Visit to Pharmaceutical /Food processing industry

SUGGESTED READING

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

B Sc. Second Year
Microbiology Semester IV
Paper- MCB -411 Food and Dairy Microbiology

Unit 1: Dairy Microbiology

(10)

- i. Definition and composition of milk. Sources of microorganisms in milk.
- ii. Desirable and undesirable changes carried out by microorganism in milk.
- iii. Types of microorganisms: Biochemical types, temperature characteristic and pathogens (bovine and human origin).
- iv. Antimicrobial substances in milk
- v. Microbiological examination of milk: SPC, DMC, Reductase test (MBRT and Resazurin) Phosphatase test.
- vi. Pasteurization and sterilization of milk:
- vii. National and international microbiological standards for dairy products (BIS, ICMSF, CODEX, Alimentary standards.

Unit 2. Food Microbiology:

(10)

- i. **Food as a substrate for microorganisms.** Major groups of bacteria, fungi, yeasts important in food microbiology.
- ii. Sources of contamination of food, factors affecting kind and number of microorganisms in food.
- iii. **Principles of food preservation:** Micro biostatic and microbicidal methods: Asepsis, removal of microorganisms, anaerobic conditions, high temp, low temp, drying, chemical preservatives, high osmotic pressure, radiation, smoking. Microbial spoilage of foods.
- iv. Classification of foods by ease of spoilage, chemical changes caused by microorganisms in food.
- v. Types of spoilage of canned and non-canned foods with organisms involved. (Tabular form).

Unit 3. Foodborne Diseases, Intoxication and Quality Assurance

(10)

- i. **Food borne diseases:** Food infections, indicators of food pathogens associated with food.
- ii. **Food intoxication:** Staphylococcal, Clostridial, Mycotoxins, Salmonellosis and Shigellosis.
- iii. Relevance of microbial standards for food safety
- iv. Government regulatory practices and policies: FDA, EPA/WHO, HACCP, FSSAI, ISO, ICMSF

Unit 4. Fermented Food and Probiotics

(10)

- i. Cheese: Classification and production
- ii. Sauerkraut, Butter, Idli.
- iii. Criterion for probiotics: Yoghurt and Curd
- iv. Mushroom as SCP.

SUGGESTED READING:

1. Food Microbiology by William C. Frazier.
2. Basic Food Microbiology by Banwart George J.
3. Food Microbiology: Fundamentals and Frontiers by Dolle.
4. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
5. Food Microbiology. 2nd Edition by Adams
6. Fundamentals of Dairy Microbiology by Prajapati.
7. Essentials of Food Microbiology. Edited by John Garbult. Arnold International Students Edition.
8. Microbiology of Fermented Foods. Volume I and II. By Brian J. Wood. Elsevier Applied Science Publication.
9. Microbiology of Foods by John C. Ayres. J. Orwin Mundt. William E. Sandinee. W. H. Freeman and Co.
10. Dairy Microbiology by Robinson. Volume II and I.
11. Food Microbiology: Fundamentals and Frontiers. 2nd Edition by Michael P. Doyle, Larry R. Beuchat and Thomas I. Montville (Eds.), ASM Publications.
12. Applied dairy microbiology edited by Elmer Marth and James Steele

B. Sc. Second Year
Microbiology Semester IV
Paper- MCB - 412 Microbial Physiology

Unit -1. Bacterial Photosynthesis (10)

- i. Photosynthetic bacteria, Photosynthetic pigments and apparatus.
- ii. Photosystem I and II, cyclic and non-cyclic flow of electrons, Hill reaction- Z scheme.
- iii. Light dependent reactions- Photolysis of water and generation of reducing power by cyclic and non-cyclic photophosphorylation.
- iv. Light independent reactions- Calvin cycle (Dark reactions of photosynthesis).
- v. Electron transport chain (ETC) in photosynthetic bacteria.
- vi. Oxygenic and Anoxygenic mechanisms.

Unit-2. Respiration (10)

- i. Definitions: Metabolism, catabolism, anabolism, respiration, and fermentation,
- ii. Types of high energy compounds- Pyrophosphate, enolic phosphates, acyl phosphates, thiol phosphate and guanidine phosphate.
- iii. ATPase- Types and features
- iv. Proton motive force-Introduction generation and functions.
- v. Oxidative phosphorylation.
- vi. Anaerobic Respiration: Concept of anaerobic respiration, components of electron transport system and energy generation of bacteria, Terminal electron acceptors- nitrate, sulphate and carbonate.

Unit-3. Membrane Transport (10)

- i. The composition and architecture of membranes, Membrane dynamics.
- ii. Solute transport across membranes: Passive transport - diffusion, Osmosis, facilitated diffusion, Active transport - Active transport systems in bacteria primary and secondary active transport using P, V and F type ATPases.
- iii. Group translocation of sugars in bacteria.
- iv. Ionophores, Ion mediated transport, transport of ions across membranes (ion pumps).

Unit-4. Bacterial Growth and Sporulation (10)

- i. Microbial growth, Growth curve,
- ii. Mathematical expression of growth.
- iii. Endospore- Sporulating bacteria, Molecular architecture of endospores,
- iv. Induction and stages of sporulation.
- v. Cytological and macromolecular changes during sporulation.
- vi. Germination of endospore

Unit V: Tutorials, Seminars and Assignments (05)

Lab Course 5 MCB-421
FOOD AND DAIRY MICROBIOLOGY (PRACTICALS)

Semester- IV

1. Direct microscopic count (DMC)
2. MBRT/ Resazurin test.
3. Isolation of Microorganisms from curd & yogurt.
4. Yoghurt fermentation.
5. Isolation of Coliform from Milk.
6. Isolation of Microorganisms from common food items (bread, pickle).
7. Enumeration & Isolation of Staphylococcus from ready to eat street foods.
8. Effect of cleansing & disinfection on microbial load of fruits & vegetables.
9. Sauerkraut fermentation.
10. Mushroom cultivation.

B. Sc. Second Year
Lab Course 6 MCB 422

1. Demonstration of utilization of sugars by Oxidation and Fermentation Test (using Hugh and Leifson's medium)
2. Effect of following on bacterial growth
 - i. UV
 - ii. pH
 - iii. Chemical disinfectants, and
 - iv. Heavy metal ions growth.
3. Enrichment, Isolation, Preparation and Application of Bioinoculants
 - i. *Azotobacter spp.*
 - ii. Rhizobium
 - iii. Blue Green Algae (Cyanobacteria).
4. Glucose uptake by *E. coli* / *Saccharomyces cerevisiae*
5. Isolation of anaerobic bacteria using reducing media
6. Isolation and purification of sulfate reducing bacteria.
7. Isolation of Photosynthetic bacteria.
8. Study principles of osmosis and diffusion using artificial membranes (dialysis membrane).
9. Isolation of bacteria oxidizing
 - i. Ammonia
 - ii. Nitrite
 - iii. Sulphur and
 - iv. Iron

References

1. Advances in Microbial Physiology. Volumes. Edited by By A.H. Rose. Academic Press, New York.
2. Applied Microbial Physiology by Rhodes.
3. Bacterial Metabolism by H.W. Doelle
4. Berg Jeremy, Tymoczko John, Stryer Lubert (2001) Biochemistry 4th Ed, W. H. Freeman, New York.
5. David A. Hall & Krishna Rao (1999) Photosynthesis (Studies in Biology) 6th Edition, Cambridge University Press, London
6. Garrett, R. H. and Grisham, C. M. (2004) Biochemistry. 3rd Ed. Brooks/Cole, Publishing Company, California.
7. Hall D. D. and Rao K. K. (1996) Photosynthesis 5th Ed., Cambridge University Press
8. Mandelstam Joel and McQuillen Kenneth (1976) Biochemistry of Bacterial Growth, Blackwell Scientific Publication London.
9. Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark (2012) Brock Biology of Microorganisms, Thirteenth edition, Benjamin Cummings, San Francisco.
10. Microbial Physiology and Metabolism by Caldwell D.R. 1995 Brown Publishers.
11. Moat Albert G. and Foster John W. (1988) Microbial Physiology 2nd Ed. John Wiley and Sons New York.
12. Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth edition, W. H. Freeman & Co. New York.
13. Prokaryotic Development by Brun. Y.V. and Shimkets L.J. 2000. ASM Press.
14. Segel Irvin H. (1997) Biochemical Calculations 2nd Ed., John Wiley and Sons, New York.
15. The Bacteria. Volumes by I.C. Gunsalus and Rogeny Stanier, Academic Press.
16. Voet Donald and Voet Judith G. (1995) Biochemistry, 2nd Ed. John Wiley and sons New York

MB-413 Skill Enhancement Elective Courses - 2
Quality Control in Food & Pharmaceutical Industries

Credits: 2

Total hours: 30

Theory: Credit: 1

Total Hours: 15

Unit 1 Microbiological Laboratory and Safe Practices

(4)

Good laboratory practices - Good laboratory practices, Good microbiological practices Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

Unit 2 Determining Microbes Pharmaceutical Samples

(3)

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water

(6)

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Food Safety and Microbial Standards

(2)

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

Practical Credit: 1 Total Hours: 15 (3 hours for each practical) Any 5

9. Methods of disinfection , autoclaving & incineration
10. Demonstration of PCR
11. Sterility testing of pharmaceutical product (Any 1)
12. Isolation of pathogen from food sample (Any 1 pathogen from one food sample)
13. Microbial quality of milk by MBRT
14. Microbial quality of milk by 10 Min Resazurin assay
15. Study of BIS standards of common foods (Any 2)
16. Visit to Pharmaceutical /Food processing industry

SUGGESTED READING

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

MB-414 Skill Enhancement Elective Courses -2

Instrumentation & Biotechniques

Credits: 2

Total hours: 30

Theory: Credit: 1

Total Hours: 15

Unit 1 Chromatography

(4)

Principles and applications of paper chromatography, Column packing and fraction collection. Gel filtration chromatography, ion-exchange chromatography and affinity chromatography, GLC, HPLC, GCMS, LCMS & (Introduction & Application)

Unit 2 Electrophoresis

(4)

Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 3 Spectrophotometry

(4)

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry. Introduction & Application of MSMS

Unit 4 Centrifugation

(3)

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

Practical Credit: 1

Total Hours: 15 (3 hours for each practical) Any 5

1. Preparation of column for Column chromatography, Preparation of eluents & Techniques of elution
2. Separation of mixtures by paper / thin layer chromatography
3. Study of GCMS & LCMS peak patterns Any 2
4. Electrophoretic separation of serum proteins by PAGE
5. Study of absorption spectra of any two biomolecules
6. Separation of DNA by centrifugation
7. Understanding density gradient centrifugation with the help of pictures
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Visit to Central Instrumentation facility Centre

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.