

RAIGANJ UNIVERSITY

Department of Microbiology



Program Course in Microbiology

RAIGANJ UNIVERSITY

Microbiology Program syllabus in CBCS system

B.Sc Microbiology Program: 1st Semester

Course Code	Course title	Course Type	(L-T-P)	Credit
BMBPDSC-1A	Microbial metabolism and food microbiology	Core	4-0-2	6
AECC-101	Environmental studies	AECC(Core) -101	4-0-0	4

B.Sc Microbiology Program : 2nd Semester

Course Code	Course title	Course Type	(L-T-P)	Credit
BMBPDSC-1B	Microbial metabolism and food microbiology	Core	4-0-2	6
AECC-102	English/MIL	AECC(Core) -102	2-0-0	2

B.Sc Microbiology Program: 3rd Semester

Course Code	Course title	Course Type	(L-T-P)	Credit
BMBPDSC-1C	Medical Microbiology and Immunology	Core	4-0-2	6
BMBPSEC-1	Microbial Quality Control in Food and Pharmaceutical Industries	Ability Enhancement Elective Course	2-0-0	2

B.Sc Microbiology Program: 4th Semester

Course Code	Course title	Course Type	(L-T-P)	Credit
BMBPDSC-1D	Medical Microbiology and Immunology	Core	4-0-2	6
BMBPSEC-2	Microbial diagnosis in health clinics	Ability Enhancement Elective Course	2-0-0	2

B.Sc Microbiology Program: 5th Semester

Course Code	Course title	Course Type	(L-T-P)	Credit
BMBPSEC-3	Food fermentation techniques	Ability Enhancement Elective Course	2-0-0	2
BMBPDSE-1A	Microbial Biotechnology	Discipline Specific Elective	4-0-2	6

B.Sc Microbiology Program: 6th Semester

Course Code	Course title	Course Type	(L-T-P)	Credit
BMBPSEC-4	Microbiological analysis of air and water	Ability Enhancement Elective Course	2-0-0	2
BMBPDSE-1B	Instrumentation and Biotechniques	Discipline Specific Elective	4-0-2	6

CHOICE BASED CREDIT SYSTEM

Semester	CORE COURSE (12)	Ability Enhancement Compulsory Course(AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective DSE (6)	Total 120 credit
I	DSC-1A (Th-4 Pr-2)	Environmental Science 4			22
	DSC-2A				
	DSC-3A				
II	DSC-1B (Th-4 Pr-2)	(English /MIL) 2			20
	DSC-2B				
	DSC-3B				
III	DSC-1C (Th-4 Pr-2)		SEC-1 2		20
	DSC-2C				
	DSC-3C				
IV	DSC-1D (Th-4 Pr-2)		SEC-2 2		20
	DSC-2D				
	DSC-3D				
V			SEC-3 2	DSE-1A (Th-4 Pr-2)	20
				DSE-2A	
				DSE-3A	
VI			SEC-4 2	DSE-1B (Th-4 Pr-2)	20
				DSE-2B	
				DSE-3B	

Core Course

DSC-1A: INTRODUCTION AND SCOPE OF MICROBIOLOGY

DSC-1B: MICROBIAL METABOLISM AND FOOD MICROBIOLOGY

DSC-1C: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

DSC-1D: MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Discipline Specific Elective (DSE)

DSE-1A: MICROBIAL BIOTECHNOLOGY

DSE-1B: INSTRUMENTATION AND BIOTECHNIQUES

Skill Enhancement Course (SEC)

SEC-1: Microbial Quality Control in Food and Pharmaceutical Industries

SEC-2: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

SEC-3: FOOD FERMENTATION TECHNIQUES

SEC-4: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

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B.Sc (Program) MICROBIOLOGY (CBCS STRUCTURE)

**DSC-1A: INTRODUCTION AND SCOPE OF MICROBIOLOGY
(THEORY)**

SEMESTER –I

TOTAL HOURS: 60 CREDITS: 4

Unit 1 History of Development of Microbiology **No. of Hours: 12**

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2 Diversity of Microorganisms **No. of Hours: 14**

Systems of classification: Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.

General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya : Algae, Fungi and Protozoa) giving definitions and citing examples.

Unit 3 Microscopy **No. of Hours: 5**

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence, Electron Microscope

Unit 4 Sterilization **No. of Hours: 5**

Moist Heat, Autoclave, Dry Heat, Hot Air Oven, Tyndallization, Filtration.

Unit 5 Bacteriology: Cell organization **No. of Hours: 14**

Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram- positive and gram- negative cell wall and archaeal cell wall, Structure, chemical composition and functions of bacterial and archaeal cell membranes, Ribosomes, inclusions, nucleoid, plasmids, structure, formation and stages of sporulation

Unit 6 Virology:**No. of Hours: 8**

Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Morphological characters: Capsid symmetry and different shapes of viruses with examples Viral multiplication in the Cell: Lytic and lysogenic cycle.

Unit 7 Microbial Interactions**No. of Hours: 2**

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation.

**DSC-1A: INTRODUCTION AND SCOPE OF MICROBIOLOGY
(PRACTICALS)****SEMESTER –I****TOTAL HOURS: 60 CREDITS: 2**

1. Microbiology Laboratory Management and Biosafety.
2. Preparation of different media: Nutrient agar, Nutrient broth
3. To perform simple staining and Gram's staining of the bacterial smear
4. To perform spore staining
5. Isolation of pure cultures of bacteria by streaking method
6. Enumeration of colony forming units (CFU) count by spread plate method/pour plate
7. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
8. Sterilization of medium using Autoclave and assessment for sterility

SUGGESTED READING

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

B.Sc (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

DSC-1B: MICROBIAL METABOLISM AND FOOD MICROBIOLOGY (THEORY)

SEMESTER – II

TOTAL HOURS: 60 CREDITS: 4

Unit 1 Bacterial growth and control

No. of Hours: 12

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media Growth: Binary fission, phases of growth, Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate. Temperature and temperature ranges of growth pH and pH ranges of growth. Effect of solute and water activity on growth. Effect of oxygen concentration on growth Nutritional categories of microorganisms.

Unit 2 Chemoheterotrophic Metabolism - Aerobic And anaerobic Respiration

No. of Hours: 24

Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors. Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction). Fermentation - Alcohol fermentation and Pasteur

effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways

Unit 3 Food as a substrate for microbial growth **No. of Hours: 4**

Intrinsic and extrinsic parameters that affect microbial growth in food Microbial spoilage of food - milk, egg, bread and canned foods.

Unit 4 Principles and methods of food preservation and food sanitation

No. of Hours: 10

Physical methods - high temperature, low temperature, irradiation, aseptic packaging Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite Food sanitation and control – HACCP

Unit 5 Dairy products, probiotics and Food-borne Diseases **No. of Hours: 10**

Fermented dairy products - yogurt, acidophilus milk, kefir, dahi and cheese Probiotics definition, examples and benefits Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus* Food infection by *Salmonella* and *E.coli*

DSC-1B: MICROBIAL METABOLISM AND FOOD MICROBIOLOGY (PRACTICAL)

SEMESTER – II

TOTAL HOURS: 60 CREDITS: 2

1. Determination of the microbiological quality of milk sample by MBRT
2. Preparation of Yogurt/Dahi
3. Study and plot the growth curve of *E. coli* by turbidimetric and standard plate count methods.
4. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.

SUGGESTED READINGS

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.

2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
7. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
8. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
9. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
10. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.

B.Sc (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

DSC-1C: MEDICAL MICROBIOLOGY AND IMMUNOLOGY (THEORY)

SEMESTER – III

TOTAL HOURS: 60 CREDITS: 4

Unit 1 Normal microflora of the human body and host pathogen interaction

No. of Hours: 8

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection,

Unit 2 Sample collection, transport and diagnosis

No. of Hours: 5

Collection, transport and culturing of clinical samples and their identification characteristics.

Unit 3 Bacterial diseases**No. of Hours: 3**

List of diseases of various organ systems and their causative agents.

Unit 4 Viral diseases**No. of Hours: 3**

List of diseases of various organ systems and their causative agents.

Unit 5 Protozoan diseases**No. of Hours: 2**

List of diseases of various organ systems and their causative agents.

Unit 6 Fungal diseases**No. of Hours: 2**

Brief description of various types of mycoses.

Unit 7 Antimicrobial agents: General characteristics and mode of action**No. of Hours: 7**

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism, Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin, Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine

Unit 8 Immune Cells and Organs**No. of Hours: 7**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen

Unit 9 Antigens and Antibodies**No. of Hours: 7**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.

Unit 10 Generation of Immune Response**No. of Hours: 6**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

Unit 11 Immunological Disorders and Tumor Immunity **No. of Hours: 5**
Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies
- Animal models
(Nude and SCID mice).

Unit 12 Immunological Techniques **No. of Hours: 5**
Principles of Precipitation, Agglutination, Immunodiffusion,
Immunoelectrophoresis, ELISA, ELISPOT.

DSC-1C: MEDICAL MICROBIOLOGY AND IMMUNOLOGY
(PRACTICAL)
SEMESTER –III
TOTAL HOURS: 60 CREDITS: 2

1. Identify bacteria on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Identification of human blood groups.
6. To perform Total Leukocyte Count of the given blood sample.
7. To perform Differential Leukocyte Count of the given blood sample.
8. To separate serum from the blood sample (demonstration).
9. To perform immunodiffusion by Ouchterlony method.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication

Unit 4 Translation**No. of Hours: 6**

Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.

Unit 5 Regulation of gene Expression**No. of Hours: 5**

Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons

Unit 6 Mutations**No. of Hours: 9**

Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens;

Uses of mutations, DNA repair mechanisms

Unit 7 Mechanisms of Genetic Exchange**No. of Hours: 10**

Transformation - Discovery, mechanism of natural competence, Conjugation - Discovery, mechanism, Hfr and F' strains, Transduction - Generalized transduction, specialized transduction

Unit 8 Plasmids and Transposable Elements**No. of Hours: 8**

Property and function of plasmids, Types of plasmids. Prokaryotic transposable elements – Insertion, Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Uses of transposons and transposition.

B.Sc MICROBIOLOGY (PROGRAM)(CBCS STRUCTURE)**DSC-1D: MICROBIAL GENETICS AND MOLECULAR BIOLOGY (PRACTICAL)****SEMESTER – IV****TOTAL HOURS: 60 CREDITS: 2**

1. Study of different types of DNA and RNA using micrographs and model / schematic representations.
2. Study of semi-conservative replication of DNA through micrographs / schematic

Representations.

3. Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylamine reagent) or UV spectrophotometer (A₂₆₀ measurement).
4. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
5. Demonstration of Bacterial Transformation and calculation of transformation efficiency.

SUGGESTED READINGS

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott, Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
8. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
9. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers
10. Russell PJ. (2009). *i* Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings

B.Sc (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

DSE-1A: MICROBIAL BIOTECHNOLOGY (THEORY)

SEMESTER –V/VI

TOTAL HOURS: 60 CREDITS: 4

Unit 1 Microbial Biotechnology and its Applications **No. of Hours: 10**

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology, Use of prokaryotic and eukaryotic microorganisms in biotechnological applications, Genetically engineered microbes for industrial application: Bacteria and yeast

Unit 2 Therapeutic and Industrial Biotechnology **No. of Hours: 10**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics. Microbial biosensors

Unit 3 Microbial Products and their Recovery **No. of Hours: 10**

Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization

Unit 4 Microbes for Bio-energy and Environment **No. of Hours: 12**

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents

Unit 5 RNAi **No. of Hours: 6**

RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen interactions

DSE-1A: MICROBIAL BIOTECHNOLOGY (PRACTICAL)

SEMESTER –V

TOTAL HOURS: 60 CREDITS: 2

1. Extraction of DNA from soil

2. PCR amplification of genomic DNA.
3. Case study to understand how the poliovirus genome was synthesized in the laboratory
4. Case study to understand how networking of glycolytic metabolic pathways in bacteria takes place.

SUGGESTED READING

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications,
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition. Elsevier Science
9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.

B.Sc (Program) MICROBIOLOGY (CBCS STRUCTURE)

DSE-1B: INSTRUMENTATION AND BIOTECHNIQUES (THEORY)

SEMESTER –VI

TOTAL HOURS: 60 CREDITS: 4

Unit 1 Microscopy

No. of Hours: 10

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Unit 2 Chromatography

No. of Hours: 14

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel

filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3 Electrophoresis

No. of Hours: 14

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

Unit 4 Spectrophotometry

No. of Hours: 10

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

Unit 5 Centrifugation

No. of Hours: 12

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

DSE-1B: INSTRUMENTATION AND BIOTECHNIQUES (PRACTICAL)

SEMESTER –V/VI

TOTAL HOURS: 60 CREDITS: 2

1. Study of fluorescent micrographs to visualize bacterial cells.
2. Ray diagrams of phase contrast microscopy and Electron microscopy.
3. Separation of mixtures by paper / thin layer chromatography.
4. Demonstration of column packing in any form of column chromatography.
5. Separation of protein mixtures by any form of chromatography.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7. Separation of components of a given mixture using a laboratory scale centrifuge.
8. Understanding density gradient centrifugation with the help of pictures.

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. 9thEd., 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.
7. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
8. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and
9. Biotechnology. Tata McGraw Hill.

B.Sc (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

SEC-1: Microbial Quality Control in Food and Pharmaceutical Industries

SEMESTER – IV

TOTAL HOURS: 30 CREDITS: 2

Unit 1 Microbiological Laboratory and Safe Practices No. of Hours: 8

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 in Food / Pharmaceutical Samples

No. of Hours: 10

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

No. of Hours: 8

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol 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 No. of Hours: 4

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

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 (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

SEC-2: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

SEMESTER – IV

TOTAL HOURS: 30 CREDITS: 2

Unit 1 Importance of Diagnosis of Diseases

No of Hours: 5

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

Unit 2 Collection of Clinical Samples

No of Hours: 5

How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

Unit 3 Direct Microscopic Examination and Culture.

No of Hours: 5

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria

Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Unit 4: Serological and Molecular Methods

No of Hours: 5

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods -PCR, Nucleic acid probes

Unit 5: Kits for Rapid Detection of Pathogens

No of Hours: 5

Typhoid, Dengue and HIV, Swine flu

Unit 6: Testing for Antibiotic Sensitivity in Bacteria

No of Hours: 5

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

SUGGESTED READING

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
5. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby
6. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.

B.Sc (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

SEC-3: FOOD FERMENTATION TECHNIQUES

SEMESTER – IV

TOTAL HOURS: 30 CREDITS: 2

Unit 1 Fermented Foods

No of Hours: 4

Definition, types, advantages and health benefits

Unit 2 Milk Based Fermented Foods

No of Hours: 8

Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3 Grain Based Fermented Foods

No of Hours: 6

Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4 Vegetable Based Fermented Foods

No of Hours: 4

Pickels, Saeurkraut: Microorganisms and production process

Unit 5 Fermented Meat and Fish

No of Hours: 4

Types, microorganisms involved, fermentation process

Unit 6 Probiotic Foods

No of Hours: 4

Definition, types, microorganisms and health benefits

Suggested Readings

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

B.Sc (PROGRAM) MICROBIOLOGY (CBCS STRUCTURE)

SEC-4: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

SEMESTER – III/IV

TOTAL HOURS: 30 CREDITS: 2

Unit 1 Aeromicrobiology **No of Hours: 4**
Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit 2 Air Sample Collection and Analysis **No of Hours: 7**
Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

Unit 3 Control Measures **No of Hours: 4**
Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit 4 Water Microbiology **No of Hours: 4**
Water borne pathogens, water borne diseases

Unit 5 Microbiological Analysis of Water **No of Hours: 7**
Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure:

presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit 6 Control Measures

No of Hours: 4

Precipitation, chemical disinfection, filtration, high temperature, UV light

Suggested Reading

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012)
2. Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press
3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
4. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
5. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press