A.S.D. GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS) KAKINADA

(Under the jurisdiction of AdikaviNannaya University)

Reaccredited by NAAC with B Grade (3rd Cycle)

BOARD OF STUDIES MEETING

B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020
(WITH EFFECT FROM 2021-2022 Admitted batch)

15th September 2021

DEPARTMENT OF MICROBIOLOGY

A.S.D. GOVT. DEGREE COLLEGE FOR WOMEN (A) KAKINADA

DEPARTMENT OF MICROBIOLOGY

AGENDA FOR THE BOARD OF STUDIES MEETING 2021-22

Dated: 15th September 2021

The members, Board of Studies, Department of Microbiology will discuss the syllabus in CBCS pattern, additional inputs, model question papers, Co-curricular activities, list of examiners and blue prints. The agenda includes.

1. Up gradation syllabus for all the Semesters v & VI (III BSc)
2. New Syllabus Implementation for I & II BSc Microbiology as per APSHE through affiliating University from this a\Academic Year 2021-22
3. Enrol the final year students in MOOC
4. Model question papers, Blue Print & Panel of Paper Setter
5. Additional inputs in the Curriculum
6. Other Academic Activities of the Department (Action Plan 2021-22)
7. Value added Courses & Study Projects
8. Proposal for Community Service/Extension Activities for the benefit of the Society.
9. Proposal for Internship for seven to ten days to Degree final year students
10. Feed back on Curriculum design and development from Students, Alumni, Teachers, Parents and industry
11. Any other proposal with the permission of the chair.

Course-Wise Syllabus

BSc	MICROBIOLOGY (Semester: I)	Credits: 4
MBT: I	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	Hrs/Wk: 4

Aim and objectives of Course

To understand History & Development of Microbiology, Microscopy, staining and sterilization techniques, Ultra-structure of cell, Different methods of microbial characterization
To study nature of viruses, viral classification, cultivation of viruses and Type study of TMV & HIV

Learning outcomes of Course

Up on completion of the course students able to

1. Explain relationship and apply appropriate terminology relating to the structure, Genetics, metabolism and ecology of prokaryotic microorganisms, Algae, viruses and Fungi.

2. Students will get basics and importance of Microbiology.

3. Demonstrate appropriate laboratory skill and techniques related to isolation, staining, identification and control of microorganisms.

UNIT-I: History of Microbiology & Place of Microorganisms in the living world

No. of hours: 12

History of Microbiology in the context of contributions of Anton von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Ivanowsky,Martinus Beijerinck and Sergei Winogradsky

Importance and applications of microbiology

Place of Microorganisms in the Living World Haeckel's three Kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese

UNIT-II: Prokaryotic microorganisms **No. of hours: 12**

Ultra-structure of Prokaryotic cell- Cell Wall, Cell Membrane, Cytoplasm, Nucleoid, Plasmid, Inclusion Bodies, Flagella Pili, Capsule, Endospore
General characteristics of Bacteria (Size, shape, arrangement, reproduction)
General characteristics of Rickettsia, Mycoplasmas, Cyanobacteria, Archaea

UNIT-III: Viruses and Eukaryotic microorganisms **No. of hours: 12**

General characteristics of viruses, Cultivation of Viruses (in brief)
Morphology, Structure and replication of TMV and Lambda Bacteriophage

Fungi - Habitat, nutrition, vegetative structure and modes of reproduction; outline classification

Algae - Habitat, thallus organization, photosynthetic pigments, storage forms of food, reproduction.

Protozoa – Habitat, cell structure, nutrition, locomotion, excretion, reproduction, encystment, outline classification

UNIT-IV: Isolation and Culture of Bacteria and Fungi

No. of hours: 12

Growth media- Natural, synthetic and semi synthetic media. Selective, Enrichment, and Differential media
Pure culture techniques - dilution-plating, Streak-plate, Spread-plate, Pour-Plate and micromanipulator.
Preservation of microbial cultures - sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature.

UNIT-V: Principles of Microscopy, Sterilization and Disinfection **No. of hours: 12**

Principles of microscopy - Bright field and Electron microscopy (SEM and TEM).

Staining Techniques - Simple and Differential staining techniques (Gram staining, Spore staining).

Sterilization and disinfection techniques –
Physical methods - autoclave, hot- air oven, pressure cooker, laminar air flow, filter sterilization,
Radiation methods - UV rays, Gamma rays.
Chemical methods - alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites.

The following topics in UNIT -III are for Internal Assessment only:

a. Fungi - Habitat, nutrition, vegetative structure and modes of reproduction; outline classification
b. Algae - Habitat, thallus organization, photosynthetic pigments, storage forms of food, reproduction

MBP- I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 30 CREDITS: 1

1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for cultivation of bacteria- Nutrient broth & Nutrient agar
3. Preparation of culture media for cultivation of fungi – Sabourauds agar
4. Sterilization of medium using Autoclave
5. Sterilization of glassware using Hot Air Oven
6. Light compound microscope and its handling
7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram -ve bacilli), Algae and Fungi.
8. Simple staining
9. Gram's staining
10. Hanging-drop method& temporary wet mount (TWM) for observation of living microrganisms.
11. Isolation of pure cultures of bacteria by serial dilution and Streak/Spread/Pour Plate Method.
12. Preservation of bacterial cultures by Serial subculturing & Slant Preparation with mineral oil overlay.
13. Observation of electron micrographs of bacterial cells

Recommended Text Books &Reference books:

- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
- Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai.
- Power, C.B. and Daginawala, H.F. (1986). General Microbiology Vol I & II
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2012). Microbiology. 5th Edition, WCB McGrawHill, New York.
- Reddy, S.M. and Reddy, S.R. (1998). Microbiology Practical Manual, 3 rd Edition, Sri Padmavathi Publications, Hyderabad.
- Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
- Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.
- Microbiology Edited by Prescott
- Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
- Gopal Reddy *et al.*, Laboratory Experiments in Microbiology

BSc	MICROBIOLOGY (Semester: II)	Credits: 4
MBT: II	MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY	Hrs/Wk: 4

Aim and objectives of Course

To understand different biomolecules, analytical techniques, bacterial nutrition, growth and metabolism

Learning outcomes of Course

Up on completion of this course students should able to:

1. Explain working principle and applications of Colorimetry, Chromatography, Spectrophotometry, Centrifugation and Gel Electrophoresis.
2. Knowledge on Microbial nutrition, bacterial growth, metabolism and Respiration.

The student will get first-hand experience on separation methods

UNIT-I: Biomolecules **No. of hours: 12**

General characters and outline classification of Carbohydrates (Monosaccharides-Glucose, Fructose, Ribose, Disaccharides- Sucrose, Lactose, Polysaccharides- Starch, glycogen, Cellulose)

General characters and outline classification of fatty acids (Saturated & Unsaturated Fatty Acids) Lipids (Simple & complex lipids)

UNIT-II: Enzymes **No. of hours: 12**

Properties and classification of Enzymes.

Biocatalysis- induced fit and lock and key models.

Coenzymes and Cofactors.

Inhibition of enzyme activity- competitive, non-competitive, uncompetitive and allosteric.

Factors effecting enzyme activity

UNIT – III: Analytical Techniques **No. of hours: 12**

Principle and applications of -

Colorimetry

Chromatography (paper, thin-layer, and column),

Spectrophotometry (UV & visible),

Centrifugation and

Gel Electrophoresis (Agarose and SDS).

UNIT – IV: Microbial Nutrition and growth **No. of hours: 12**

Nutritional requirements of Microorganisms

Nutritional groups of microorganisms- autotrophs, heterotrophs, lithotrophs, organotrophs, phototrophs, chemotrophs

Microbial Growth- different phases of growth in batch cultures; Synchronous, continuous, biphasic growth.

Factors influencing microbial growth

Methods for measuring microbial growth - Direct microscopy, viable count estimates, turbidometry and biomass.

UNIT- V : Microbial metabolism **No. of hours: 12**

Aerobic respiration - Glycolysis, TCA cycle, ED Pathway, Electron transport
Oxidative and substrate level phosphorylation.
Anaerobic respiration (Nitrate and sulphate respiration)
Fermentation- lactic acid and ethanol fermentations
Outlines of oxygenic and anoxygenic photosynthesis in bacteria

MBP – II: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

TOTAL HOURS: 30 CREDITS: 1

1. Qualitative Analysis of Carbohydrates.

2. Qualitative Analysis of Aminoacids.

3. Colorimetric estimation of proteins by Biuret / Lowry method.

4.Separation of components of a given mixture using a laboratory scale centrifuge.

5. Separation of mixtures by paper / thin layer chromatography.

6. Demonstration of column packing in any form of column chromatography.

7. Effect of temperature/pH / Salt concentration on bacterial growth

8. Demonstration of electrophoretic technique

9. Study and plot the growth curve of E. coli by turbidimetric and Standard Plate Count methods

Recommended Text Books &Reference books:

Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.

Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.

Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.

Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons

White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford UniversityPress, New York.

BSc	MICROBIOLOGY (Semester: III)	Credits: 4
MBT: III	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	Hrs/Wk: 4

Aim and objectives of Course

To understand different biomolecules, analytical techniques, bacterial nutrition, growth and metabolism

Learning outcomes of Course

Up on completion of this course students should able to:

1. Understand the nature of genetic material, process of DNA replication and the role of DNA and RNA.
2. Understand gene structure, genetic code and the process of transcription, translation and regulation of gene expression in bacteria.
3. Define and classify mutations, understand their molecular basis.
4. Familiarize with genetic recombination in bacteria, and Genetic engineering technology

UNIT- I: Nucleic acids **No. of hours: 12**

DNA and RNA - Role in heredity-The central dogma
Watson and Crick model of DNA
Types of RNA, structure, and functions
Organization of DNA in prokaryotes

UNIT- II : Genetic material and replication **No. of hours: 12**

Experiments which established DNA as genetic material
RNA as genetic material
Mechanism of DNA Replication in Prokaryotes
Proof of semi conservative mechanism of replication (Meselson - Stahl Experiment)

UNIT- III: Gene expression and regulation **No. of hours: 12**

Concept of gene - Muton, recon and cistron.
Genetic code
Protein synthesis - Transcription and translation in Prokaryotes
Regulation of gene expression in bacteria - *lac* operon

UNIT- IV: Mutations, damage and repair **No. of hours: 12**

Outlines of DNA damage and repair mechanism
Mutations - spontaneous and induced
Chromosomal aberrations - deletions, inversions, tandem duplications, insertions
Point mutations- base pair changes, frame shifts
Mutagens - Physical and Chemical mutagens
Bacterial recombination - Transformation, Conjugation, Transduction (Generalized and specialized

transductions)

UNIT- V: Genetic engineering **No. of hours: 12**

Basic principles of genetic engineering.
Restriction endonucleases, DNA ligases.
Vectors – plasmids (pBR322), Cosmids, Phagemids, lambda phage vector, M 13 vectors.
Outlines of gene cloning methods.
Polymerase chain reaction.
Genomic and cDNA libraries.
General account on application of genetic engineering in industry, agriculture, and medicine.

MBP – III: MOLECULAR BIOLOGY AND MICROBIAL GENETICS

TOTAL HOURS: 30 **CREDITS: 1**

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. Isolation of genomic DNA from *E. coli*
4. Estimation of DNA using UV spectrophotometer.
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
6. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS - PAGE).
7. Problems related to DNA and RNA characteristics, Transcription and Translation.
8. Induction of mutations in bacteria by UV light.
9. Instrumentation in molecular biology - Ultra centrifuge, Transilluminator, PCR

Recommended Text Books &Reference books:

- Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
  Freifelder, D. (1997). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
- Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
- Lewin, B. (2000). Genes VIII. Oxford University Press, England.
- Maloy, S.R., Cronan, J.E. and Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers, London.
- Ram Reddy, S., Venkateshwarlu, K. and Krishna Reddy, V. (2007) A text Book of Molecular Biotechnology. Himalaya Publishers, Hyderabad.
- Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). Principles of Genetics. 5 th Edition. McGraw Hill, New York.
- Smith, J.E. (1996). Biotechnology, Cambridge University Press.
- Snyder, L. and Champness, W. (1997). Molecular Genetics of Bacteria. ASM press,
- Strickberger, M.W. (1967). Genetics. Oxford & IBH, New Delhi.

- Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.

BSc	MICROBIOLOGY (Semester: IV)	Credits: 4
MBT: IV	IMMUNOLOGY AND MEDICAL MICROBIOLOGY	Hrs/Wk: 4

Aim and objectives of Course

To study types of immunity, immune organs, cells, antibodies and antigen-antibody interactions.

To learn diagnostic and pathogenesis of various diseases. Antimicrobial defense and different toxins and vaccines.

Learning outcomes of Course

Up on completion of the course students able to

1. Explain No-specific body defence and the immune response
2. Develop knowledge on disease transmission and control
3. Demonstrate on collection and handling of laboratory specimens
4. Develop an information making personal health decision in regard to infectious diseases.
5. Student can safeguard himself & society and can work diagnostics and hospitals.

UNIT-I: Immune System **No. of hours: 12**

Concept of Innate and Adaptive immunity

Primary and secondary organs of immune system - thymus, bursa fabricus, bone marrow, spleen, lymph nodes.

Cells of immune system- Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils

Complement system (in brief)

UNIT-II : Immune response **No. of hours: 12**

Characteristics of antigen (Foreignness, Molecular size, Heterogeneity and solubility) Haptens.

Antibodies - basic structure and types and functions (Immune complex formation and elimination - Agglutination, Precipitation, Neutralization, Complement fixation, Phagocytosis)

Generation of Humoral Immune Response (Plasma and Memory cells)

Generation of Cell Mediated Immune Response

MHC- Functions of MHC I & II molecules

Hypersensitivity- definition and types (in brief)

Autoimmunity (in brief)

UNIT- III: Microbes in Health and Disease **No. of hours: 12**

Normal flora of human body.
Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Opportunistic infections, Nosocomial infections.
General account on microbial diseases – causal organism, pathogenesis, epidemiology, diagnosis, prevention, and control of the following
Bacterial diseases - Tuberculosis, Typhoid.
Fungal diseases - Candidiasis.
Protozoal diseases - Malaria.
Viral Diseases – Corona virus and AIDS

UNIT- IV: Principles of Diagnosis **No. of hours: 12**

General principles of diagnostic microbiology- Collection, transport of clinical samples
Identification by Culturing & Biochemical characteristics (IMViC)
Identification by molecular assays (PCR, RT-PCR, DNA probes)
Identification by serological tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation)

UNIT- V: Prevention and Treatment **No. of hours: 12**

Vaccines
Monoclonal antibodies- Production and application
Antimicrobial agents- General modes of action of antibacterial (Penicillin), antifungal (Amphotericin), antiviral (Amantadine) agents
Interferons
Tests for antimicrobial susceptibility (Disc diffusion)
Antibiotic resistance in bacteria

MBP -V: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

TOTAL HOURS: 30 **CREDITS: 1**

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Immunodiffusion by Ouchterlony method.
4. Identification of any of the bacteria (*E. coli*, *Pseudomonas, Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics:

IMViC, urease production and catalase tests

5. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar
6. Antibacterial sensitivity by Kirby-Bauer method
6. Determination of Minimal Inhibitory Concentration (MIC) of an antibiotic
7. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)
8. Study of various stages of malarial parasite in RBCs using permanent mounts.
9. Phenol coefficient test
10. Isolation of Normal flora of human body (Hands, Feet, Nostrils, Teeth Surface) by swab method.
11. Evaluation of Hand Sanitizer Effectiveness by Filter Paper Disc Method & thumb impression method.

Recommended Text Books &Reference books:

- Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
- 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.
- Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
- Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
- Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
- Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Microbiology. 4th edition. Elsevier Publication.
- Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.

BSc	MICROBIOLOGY (Semester: IV)	Credits: 4
MBT: V	MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY	Hrs/Wk: 4

Aim and objectives of Course

1. To study role of microorganisms in nutrient cycling, microorganism in waste treatment and degradation of xenobiotics
2. To determine the potability of drinking water
3. To study concepts of screening and strain improvement, media, Fermentation, assays with examples of industrially important processes

Learning outcomes of Course

Up on completion of the course students able to

1. Understand fundamental concept in soil microbial diversity, basic concept of biogeochemical cycles and plant growth promotion and plant diseases
2. Understands the role of microorganisms in treatment of solid and liquid waste.
3. Acquire knowledge on application of microorganisms in agro – environmental fields.
4. Get basic information design of fermenter, fermentation processes and Single cell proteins.
5. Self-reliance in the industrial application of Microbiology in life and industry.
6. Entrepreneurship can be established with the gained knowledge.

UNIT - I: Microbial Ecology **No. of hours: 12**

Role of microorganisms in Biogeochemical cycles (Carbon, nitrogen, phosphorus)
Microbe-microbe interactions - Synergism, mutualism, commensalism, antagonism, competition, parasitism, predation
Plant- Microbe interactions - Plant growth promoting Microorganisms, Plant pathogens

UNIT - II : Microorganisms in Environment **No. of hours: 12**

Microbes in waste management- solid and liquid waste (aerobic and anaerobic)
Microbes in degradation of Xenobiotics
Microbes in drinking water- detection of potability by (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique
Microbes in food - intrinsic and extrinsic parameters that affect microbial growth in food

UNIT - III: Industrial Microbiology **No. of hours: 12** Industrial important Microorganisms- Yeasts & Moulds , Bacteria , Actinomycetes .
Screening techniques.
Strain improvement techniques.

UNIT -IV: Fermentation processes **No. of hours: 12**

Design of fermenter (for control of pH, temperature, dissolved oxygen, foaming and aeration)

Types of fermentation processes - solid state, liquid state, batch, fed-batch, continuous.
Fermentation media (Carbon source, nitrogen source, minerals, vitamins & growth factors, Buffers, Precursors, Antifoam agents, water, oxygen)
Examples of Crude media; molasses, corn- steep liquor, sulphite waste liquor, whey.
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT - V: Microbial Productions **No. of hours: 12**

Microbial production of Industrial products: Citric acid, Ethanol, Penicillin, Glutamic acid, vitamin B12, Amylase, Yogurt
Microbial cells as food- SCP

MBP - V: MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY

Total hours: 30 **Credits: 1**

1. Microbial fermentation for the production and estimation of ethanol
2. Isolation of amylase producing microorganisms from soil
3. Isolation of food spoilage microorganisms from spoiled food sample.
4. MPN test
5. Demonstration of fermenter
6. Production of wine from grapes
7. Growth curve and kinetics of any two industrially important microorganisms.
8. Microbial fermentation for the production and estimation of citric acid
9. Preparation of yoghurt.
10. Crowded plate technique
11. Isolation of microorganism from soil
12. Isolation of microorganism from different water samples

Recommended Text Books &Reference books:

- Atlas RM and Bartha R. (2000). **Microbial Ecology: Fundamentals & Applications.** 4th edition. Benjamin/Cummings Science Publishing, USA
- Barton LL & Northup DE (2011). **Microbial Ecology**. 1st edition, Wiley Blackwell, USA
- Campbell RE. (1983). **Microbial Ecology**. Blackwell Scientific Publication, Oxford, England.
- Coyne MS. (2001). **Soil Microbiology: An Exploratory Approach.** Delmar Thomson Learning.
- Lynch JM & Hobbie JE. (1988). **Microorganisms in Action: Concepts & Application in Microbial Ecology.** Blackwell Scientific Publication, U.K.
- Madigan MT, Martinko JM and Parker J. (2014). **Brock Biology of Microorganisms**. 14th edition. Pearson/ Benjamin Cummings
- Maier RM, Pepper IL and Gerba CP. (2009). **Environmental Microbiology**. 2nd edition, Academic Press
- Martin A. (1977). **An Introduction to Soil Microbiology**. 2nd edition. John Wiley & Sons Inc. New York & London. Adams MR and Moss MO. (1995). **Food Microbiology**. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
- Banwart JM. (1987). **Basic Food Microbiology**. 1st edition. CBS Publishers and Distributors, Delhi, India.
- Casida LE. (1991). **Industrial Microbiology**. 1st edition. Wiley Eastern Limited.

- Crueger W and Crueger A. (2000). **Biotechnology: A textbook of Industrial Microbiology**. 2nd Edition. Panima Publishing Company, New Delhi
- Frazier WC and Westhoff DC. (1992). **Food Microbiology**. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – SEMESTER- V
(For Admitted Batch2019-2020)

MBT- 501 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

Learning Out comes:

1. **The student will have a fundamental concepts in soil microbiology, soil microbial diversity, basic concept of nitrogen fixation and plant growth promotion.**
2. **Understands the role of microorganisms in treatment of solid and liquid waste.**
3. **The student will acquire knowledge on application of microorganisms in agro – environmental fields.**
4. **Knowledge on plant disease control.**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT - I **No. of hours: 8**

Terrestrial Environment: Soil profile and soil microflora
Aquatic Environment: Microflora of fresh water and marine habitats
Atmosphere: Aeromicroflora and dispersal of microbes

UNIT – II **No. of hours: 8**

Role of microorganisms in nutrient cycling (Carbon, nitrogen, phosphorus).
Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique.Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

UNIT – III **No. of hours: 6**

Outlines of Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill).
Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

UNIT – IV **No. of hours: 7**

Plant Growth Promoting Microorganisms - Mycorrhizae, Rhizobia, *Azospirillum, Azotobacter, Frankia,* phosphate-solubilizers and Cyanobacteria.

Outlines of biological nitrogen fixation (symbiotic, non-symbiotic).
Biofertilizers - *Rhizobium*.

UNIT – V **No. of hours: 7**

Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases - groundnut rust, Citrus canker and tomato leaf curl. Principles of plant disease control.

Additional inputs:

Determination quality of different water sample by MPN method

MBP- 501 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

TOTAL HOURS: 36
CREDITS: 2

1. Preparation of soil extract agar and any one culture media for algal growth
2. Isolation of microbes (bacteria and fungi) from soil.
3. Study of air micro flora by petriplate exposure method.
4. Microbiological Analysis of potable water Standard Plate Count
5. Determination of Dissolved Oxygen (DO) of water samples.
6. Isolation of *Rhizobium* from root nodules.
7. Isolation of actinomycetes on I.S.P. media (International Streptomyces project media)
8. Observation of photo micrographs of plant diseases of local importance - Citrus canker, Tikka disease of Groundnut, Bhendi yellow vein mosaic, Rusts, Smuts, Powdery mildews, Tomato leaf curl.

SUGGESTED READINGS

Atlas RM and Bartha R. (2000). **Microbial Ecology: Fundamentals & Applications.** 4th edition. Benjamin/Cummings Science Publishing, USA

Barton LL & Northup DE (2011). **Microbial Ecology**. 1st edition, Wiley Blackwell, USA

Campbell RE. (1983). **Microbial Ecology**. Blackwell Scientific Publication, Oxford, England.

Coyne MS. (2001). **Soil Microbiology: An Exploratory Approach.** Delmar Thomson Learning.

Lynch JM & Hobbie JE. (1988). **Microorganisms in Action: Concepts & Application in Microbial Ecology.** Blackwell Scientific Publication, U.K.

Madigan MT, Martinko JM and Parker J. (2014). **Brock Biology of Microorganisms**. 14th edition. Pearson/ Benjamin Cummings

Maier RM, Pepper IL and Gerba CP. (2009). **Environmental Microbiology**. 2nd edition, Academic Press

Martin A. (1977). **An Introduction to Soil Microbiology**. 2nd edition. John Wiley & Sons Inc. New York & London.

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B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – SEMESTER- V

(For Admitted Batch2019-2020)

MBT- 601: FOOD AND INDUSTRIAL MICROBIOLOGY

Learning Out comes:

1. **The course aim to provide general principles of food microbiology**
2. **It is assumed that students will have get basic information on spoilage, principle of food preservation and Single cell proteins.**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT- I **No. of hours: 8**

Intrinsic and extrinsic parameters that affect microbial growth in food
Microbial spoilage of food - fruits, vegetables, milk, meat, egg, bread and canned foods
Food intoxication (botulism).
Food-borne diseases (salmonellosis) and their detection.

UNIT – II **No. of hours: 7**

Principles of food preservation - Physical and chemical methods.
Fermented Dairy foods – cheese and yogurt.
Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw). Probiotics and their benefits.

UNIT – III No. of hours: 6

Microorganisms of industrial importance – yeasts,(Saccharomyces cerevisiae) moulds,(Aspergillus niger) Bacteria(E.coli), actinomycetes (Streptomyces griseus).
Outlines of Isolation and Screening and strain improvement of industrially-important microorganisms.

UNIT – IV **No. of hours: 8**

Types of fermentation processes – solid state, liquid state, batch, fed-batch, continuous.
Basic concepts of Design of fermenter.

Ingredients of Fermentation media
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT – V **No. of hours: 7**

Microbial production of Industrial products - Citric acid, Ethanol, amylases, penicillin, glutamic acid and vitamin B12.

Additional inputs: Mushroom cultivation

MBP- 601 FOOD AND INDUSTRIAL MICROBIOLOGY

TOTAL HOURS: 36 **CREDITS: 2**

1. Isolation of bacteria and fungi from spoiled bread/fruits/vegetables
2. Preparation of Yogurt/Dahi
3. Determination of the microbiological quality of milk sample by MBRT
4. Isolation of antagonistic microorganisms by crowded plate technique
5. Design of Fermenter
6. Microbial fermentation for the production and estimation of ethanol from Grapes.
7. Microbial fermentation for the production and estimation of citric acid.

SUGGESTED READING

Adams MR and Moss MO. (1995). **Food Microbiology**. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

Banwart JM. (1987). **Basic Food Microbiology**. 1st edition. CBS Publishers and Distributors, Delhi, India.

Casida LE. (1991). **Industrial Microbiology**. 1st edition. Wiley Eastern Limited.

Crueger W and Crueger A. (2000). **Biotechnology: A textbook of Industrial Microbiology**. 2nd Edition. Panima Publishing Company, New Delhi

Frazier WC and Westhoff DC. (1992). **Food Microbiology**. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

Jay JM, Loessner MJ and Golden DA. (2005). **Modern Food Microbiology**. 7th edition, CBS Publishers and Distributors, Delhi, India

Patel AH. (1996). **Industrial Microbiology** .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India

Stanbury PF, Whitaker A and Hall SJ. (2006). **Principles of Fermentation Technology.** 2nd edition, Elsevier

Science Ltd.

Tortora GJ, Funke BR, and Case CL. (2008). **Microbiology: An introduction**. 9th Edition. Pearson Education

Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's **Microbiology**. 9th Edition. McGraw Hill Higher education

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – SEMESTER- VI

(For Admitted Batch2019-2020)

MBT- 701 MICROBIAL BIOTECHNOLOGY (Elective)

Learning Out comes:

1. **Student should be able to demonstrate with the wide diversity of microbes and their potential for use in microbial biotechnology**
2. **It is assumed that students will have get outlines of intellectual property rights.**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT- I

No. of Hours: 8

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

UNIT- II

No. of Hours: 7

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine).
Over view of production and applications of Microbial polysaccharides, Bioplastics and Microbial biosensors

UNIT- III

No. of Hours: 10

Microbial based transformation of steroids and sterols.
Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.
Immobilization methods and their application: Whole cell immobilization

UNIT- IV

No. of Hours: 7

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- V **No. of Hours: 4**

Outlines of Intellectual Property Rights: Patents, Copyrights, Trademarks

MBP- 701 MICROBIAL BIOTECHNOLOGY

TOTAL HOURS: 36 **CREDITS: 2**

1. Yeast cell immobilization in calcium alginate gels
2. Enzyme immobilization by sodium alginate method
3. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal Single Cell Proteins

SUGGESTED READING

Crueger W, Crueger A (1990) Biotechnology: **A text Book of Industrial Microbiology** 2nd edition Sinauer associates, Inc.

Demain, A. L and Davies, J. E. (1999). **Manual of Industrial Microbiology and Biotechnology**, 2nd Edition, ASM Press.

Glazer AN and Nikaido H (2007) **Microbial Biotechnology**, 2nd edition, Cambridge University Press

Glick BR, Pasternak JJ, and Patten CL (2010) **Molecular Biotechnology** 4th edition, ASM Press

Gupta PK (2009) **Elements of Biotechnology** 2nd edition, Rastogi Publications

Prescott, Harley and Klein's **Microbiology** by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.

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Swartz, J. R. (2001). **Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology**, 12, 195–201.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – SEMESTER- VI

(For Admitted Batch2019-2020)

CLUSTER PAPERS UNDER ELECTIVE 801 (801 A1, 801A2 & 801A3)

MBT- 801 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Learning Out comes:

1. **Develop knowledge on disease transmission and control**
2. **Demonstrate on collection, handling and diagnosis of laboratory specimens**
3. **Develop a information making personal health decision in regard to infectious diseases.**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT- I **No. of hours: 8**

Study of Bacterial,(Tuberculosis and Typhoid) Viral,(Influenza and HIV) Fungal (Aspergillosis and Candidiasis)and Protozoan Malaria and Amebiasis)Diseases affecting humans.

UNIT- II **No. of hours: 8**

Collection of 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- III **No. of hours: 8**

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- IV **No. of hours: 6**

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

Typhoid, Dengue and HIV, Swine flu.

UNIT- V **No. of hours: 6**

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

MBP- 801 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

TOTAL HOURS: 36 **CREDITS: 2**

1. Collection transport and processing of any one of the following clinical specimens (Blood/ Urine/ Stool/Sputum). Receipts, Labeling, recording and dispatching clinical specimens.
2. Isolation of bacteria in pure culture and Antibiotic sensitivity.
3. Identification of common bacteria(E.coli, Staphylococus aureus and Streptococus sps) by studying their morphology, cultural character, Biochemical reactions, and other tests.
4. Maintenance and preservation of stock culture.

SUGGESTED READING

Ananthanarayan R and Paniker CKJ (2009) **Textbook of Microbiology**, 8th edition, Universities Press Private Ltd.

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

Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical **Medical Microbiology**, 14th edition, Elsevier.

Randhawa, VS, Mehta G and Sharma KB (2009) **Practicals and Viva in Medical Microbiology** 2nd edition, Elsevier India Pvt Ltd

Tille P (2013) Bailey's and Scott's **Diagnostic Microbiology**, 13th edition, Mosby

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – SEMESTER- VI

(For Admitted Batch2019-2020)

MBT- 801 A2: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

Learning Out comes:

1. **Develop knowledge and skills on microbiological laboratory safety- General rules and regulations.**
2. **Develop skills on disinfection of instruments and equipments in laboratory and Hospitals**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT – I **No. of Hours: 8**

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 – II **No. of Hours: 8**

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

UNIT – III **No. of Hours: 8**

Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – IV **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 – V **No. of Hours: 4**

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

MBP- 801 A2: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

TOTAL HOURS: 36 **CREDITS: 2**

1. Microbiological laboratory safety- General rules & Regulations.

2. Sterility tests for Instruments – Autoclave & Hot Air Oven

3. Disinfection of selected instruments & Equipments

4. Sterility of Air and its relationship to Laboratory & Hospital sepsis.

5. Sterility testing of Microbiological media

6. Sterility testing of any one Pharmaceutical product

7. Standard qualitative analysis of water.

8.Microbiological analysis of homogenized food samples by direct microscopic count

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – SEMISTER-VI

(For Admitted Batch2019-2020)

MBT- 801 A3: BIOFERTILIZERS AND BIOPESTICIDES

Learning Out comes:

1. **Develop knowledge and skills on mass multiplication and field application of biofertilizers and biopesticides.**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT – I **No of Hours: 10**

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N_2 fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

Frankia from non-legumes and characterization.

Cyanobacteria from *Azolla*, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT – II **No of Hours: 6**

Free living *Azospirillum*, *Azotobacter* - isolation, characteristics, mass inoculum production and field application.

UNIT – III **No of Hours: 6**

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

UNIT – IV **No of Hours: 7**

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT – V **No of Hours: 7**

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides. *Bacillus thuringiensis* - production, Field applications.

Viruses – NPV cultivation and field applications.

MBP- 801 A3: BIOFERTILIZERS AND BIOPESTICIDES

TOTAL HOURS: 36 **CREDITS: 2**

1. Isolation of *Rhizobium* from root nodules.

3. Isolation of phosphate solubilizers from soil

4. Staining and observation of VAM

3. A visit to biofertilizer production unit.

SUGGESTED READINGS

Agarwal SK (2005) **Advanced Environmental Biotechnology**, APH publication.

Kannaiyan, S. (2003). **Bioetchnology of Biofertilizers,** CHIPS, Texas.

Mahendra K. Rai (2005). **Hand book of Microbial biofertilizers**, The Haworth Press, Inc. New York.

Reddy, S.M. et. al. (2002). **Bioinoculants for sustainable agriculture and forestry**, Scientific Publishers.

Saleem F and Shakoori AR (2012) **Development of Bioinsecticide,** Lap Lambert Academic Publishing GmbH KG

Subba Rao N.S (1995) **Soil microorganisms and plant growth** Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.