A.S.D Govt. Degree College for Women (A), Kakinada

Department of Microbiology

2020-21

BSc	MICROBIOLOGY (Semester: I)	**Credits: 4**
MBT: I	**Introduction To Microbiology And Microbial Diversity**	**Hrs/Wk: 4**

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

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 Skill **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:

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 : Skill & Employability
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: Skill & Employability
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.

MBP- I: Introduction To Microbiology And Microbial Diversity

Skill & Employability

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

BSc	MICROBIOLOGY (Semester: II)	Credits: 4
MBT: II	Microbial Physiology And Biochemistry	Hrs/Wk: 4

UNIT-I: Biomolecules

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
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 : Skill & Employability
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: Skill

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: Enterpreneurship

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

Skill & Employability

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

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MICROBIOLOGY (Semester: III)

MB203307: Molecular Biology and Microbial Genetics

UNIT- I:

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 :

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:

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:

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:

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

Skill & Employability, Enterpreneurship

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
    - **Additional** inputs: 1. Protein synthesis in eukaryotes

      2. Post translational modifications

Microbiology (Semester: IV)

Immunology and Medical Microbiology

UNIT-I:

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 :

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:

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:

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:

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

Skill , Enterpreneurship **&** Employability

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.

- **Additional inputs:** Isolation of normal flora from body parts

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MICROBIOLOGY (Semester: 5)

ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

UNIT – I

• Terrestrial Environment: Soil profile and soil micro flora

• Aquatic Environment: Micro flora of fresh water and marine Habitats

• Atmosphere: Aeromicroflora and dispersal of microbes

UNIT – II

• 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 fecalcoli forms (b) Membrane filter technique. Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

UNIT – III

• 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

• Plant Growth Promoting Microorganisms - Mycorrhizae, Rhizobia, Azospirillum, Azotobacter, Frankie, • Phosphate-solubilizers and Cyanobacteria.

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

UNIT – V

• Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases - groundnut rust, Citrus canker and tomato leafcurl.

• Principles of plant disease control.

Additional inputs: Determination of quality of water by MPN

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FOOD AND INDUSTRIAL MICROBIOLOGY

MICROBIOLOGY (Semester: 5)

UNIT – 1 Skill, Employability

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 Skill, Employability & Enterpreneurship

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 Skill, Employability & Enterpreneurship **No. of Hours: 8**

Microorganisms of industrial importance – yeasts, (Saccharomyces cerevisiae) moulds, (Aspergillusniger) Bacteria (E.coli), Actinomycetes (Streptomyces griseous).
• 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 Fermentor.
• Ingredients of Fermentation media

UNIT – V Skill, Employability **No. of Hours: 12**

Microbial production of Industrial products - Citric acid, Ethanol, amylases, penicillin, glutamic acid and vitamin B12.
Additional input: Mushroom cultivation

MBP – FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY

Skill, Employability & Enterpreneurship

1. Isolation of bacteria and fungi spoiled bread / fruits / vegetables
2. Preparation of yogurt / dahi
3. Determination of microbiological quality of milk sample by MBRT
4. Isolation of antagonistic microorganisms by crowded platetechnique
5. Design of Fermenter(identification of diagrams of various types of Fermentors and labeling of parts)
6. 6.Microbial fermentation for the production and estimation of ethanol fromGrapes.
7. 7.Microbial fermentation for the production and estimation of citricacid.

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III B.Sc Microbiology Syllabus

Semester: V: Microbial Biotechnology

UNIT- I

• 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: 10

• 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

MICROBIAL BIOTECHNOLOGY
Practical Syllabus (2019-20)

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

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BSc Microbiology Semester: VI

Paper 8A1: Microbial Diagnosis in Health Clinics

UNIT- I

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

UNIT- II Skill, Employability

• 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 Skill, Employability

• 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 : Skill, Employability,Entrepreneurship

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

• Typhoid, Dengue and HIV, Swine flu.

UNIT- V Skill, Employability

• 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

Practical syllabus: Microbial Diagnosis in Health Clinics

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, Staphylococcus aureus and Streptococcus sps) by studying their morphology, cultural character, Biochemical reactions, and other tests.
4. Maintenance and preservation of stock culture.

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BSc Microbiology Syllabus

Sem VI: 8A2: Microbial Quality Control in Food and Pharmaceutical Industries

Skill, Employability & Enterpreneurship

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 Skill, Employability

• Enrichment culture technique, Detection of specific microorganisms - on XLD agar, SalmonellaShigellaAgar, 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 Skill, Employability & Enterpreneurship

• 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: Microbial Quality Control in Food and Pharmaceutical Industries

PRACTICALS: Skill, Employability & Enterpreneurship

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

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BSc Microbiology Syllabus

Semester VI: 8A3 -BIOFERTILIZERS AND BIOPESTICIDES

Skill, Employability & Enterpreneurship

UNIT – I:

• General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.
• Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, innoculum production and field application, legume/pulses plants
• Frankia from non-legumes and characterization.
• Cyanobacteria and Azolla, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT – II

• Free living Azospirillum, Azotobacter - isolation, characteristics, mass innoculum production and field application.

UNIT – III

• Phosphate solubilizing microbes - Isolation, characterization, mass innoculum production, field application

UNIT – IV

• Importance of mycorrizal innoculum, types of Mycorrhizae and associated plants, Mass innoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT – V

• General account of microbes used as bioinsecticides and their advantages over synthetic pesticides. Bacillusthuringiensis- production, Field applications.
• Viruses – NPV cultivation and field applications.