

**PROPOSED SYLLABUS (2019-20) for B.Sc Microbiology**  
**Code: BS 104, DSC**  
**B.Sc I year: I Semester Paper-I Theory**

**Paper Title: Introductory Microbiology**

**4HPW-credits: 4**

**1<sup>st</sup> Credit: Introduction**

Microbiology: Definition and scope. History of microbiology: Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Iwanoswky, Beijernik, Winogradsky and Alexander Fleming.

Microbiological Techniques: Sterilization and Disinfection - Physical methods (dry and moist heat), filtration, radiation. Chemical methods (alcohols, phenols, aldehydes, fumigants)

**2<sup>nd</sup> Credit: Microscopy and Staining methods**

Principles and applications of Microscopy-Bright field, Dark field, Phase-contrast, Fluorescent and Electron microscopy (SEM and TEM). Ocular and stage micrometry.

Principles and types of stains-Simple stain, Differential stain, Negative stain.

Structural stain: spore, capsule, flagella

**3<sup>rd</sup> Credit: Classification, Isolation and Identification of Microorganisms**

Classification of living organisms; Haeckel, Whittaker and Carl Woese systems.

Differentiation of prokaryotes and eukaryotes. Classification and identification of bacteria as per the second edition of Bergey's manual of systematic bacteriology. Classification of protozoa, microalgae and fungi.

Growth media – synthetic, semi- synthetic, selective, enrichment and differential media.

Isolation of Pure culture techniques - Enrichment culturing, Dilution plating, streak plate, spread plate, Micromanipulator. Preservation of Microbial cultures – Sub culturing, overlaying cultures with minerals oils, sand cultures, lyophilization, storage at low temperature.

**4<sup>th</sup> Credit: Structure and General Characteristics of Microorganisms**

General characteristics of prokaryotes: Bacteria, Archaea bacteria. Rickettsia, Mycoplasma, Cyanobacteria and Actinomycetes. Ultra structure of bacterial cell: cell wall, cell membrane, ribosomes, nucleoid, capsule, flagella, fimbriae, endospores & storage granules.

General characteristics of eukaryotes: protozoa, microalgae and fungi.

General characteristics and classification of virus. Morphology and structure of lambda bacteriophage (lytic and lysogeny), TMV and HIV.

References:

1. Michael J. Pelczar, Jr. E.C.S.Chan, Noel R. Krieg Microbiology Tata McGraw- Hill Publisher.
2. Prescott, M.J., Harley, J.P. and Klein Microbiology 5<sup>th</sup> Edition, WCB Mc GrawHill, New York.
3. Madigan, M.T., Martinkl, J.M and Parker.j. Broch Biology of Microorganism, 9<sup>th</sup> Edition, MacMillan Press, England.
4. Dube, R.C. and Maheshwari, D.K. General Microbiology S Chand, New Delhi.

**I-Semester Practical Paper-I**

**Introductory Microbiology**

**2HPW-Credits-1**

**5<sup>th</sup> Credit: Practicals**

1. Compound microscope and its handling.
2. Sterilization techniques: Autoclave, Hot air oven and filtration
3. Calibration of microscope by ocular , stage micrometer and measurement of bacterial and fungal spores.
4. Simple and differential staining (Gram staining), Spore staining, capsule staining and flagellar staining.
5. Microscopic observation of bacteria (Gram positive bacilli and cocci, Gram negative bacilli), cyanobacteria (Nostoc, Spirulina), fungi (Saccharomyces, Rhizopus, Aspergillus, Penicillium)
6. Bacterial motility: hanging drop method
7. Preparation of culture media: Solid/Liquid.
8. Isolation of bacteria by serial dilution and pure cultures methods (streak, spread and pour plate techniques)
9. Preservation of microbial cultures- Slant, Stab, mineral oil overlay and glycerol stocks
10. Bacterial biochemical identification-IMViC test, carbohydrate fermentation test

References:

1. Experiments in Microbiology by K.R. Aneja.
2. Gopal Reddy.M., Reddy. M.N., Sai Gopal, DVR and Mallaiah K.V. Laboratory Experiments in Microbiology.
3. Dubey, R.C. and Maheshwari, D.K. Practical Microbiology, S. Chand and Co New Delhi.
4. Alcamo, I.E. Laboratory Fundamentals of Microbiology. Jones and Bartlett Publishers, USA.

**KAKATIYA UNIVERSITY**  
**B. Sc (CBCS) Microbiology – III Year**  
**Semester-V – B (Discipline Specific Elective)**  
**INDUSTRIAL AND FOOD MICROBIOLOGY**

**Practical syllabus**

1. Microbial fermentation for the production and estimation of amylase.
2. Microbial fermentation for the production and estimation of citric acid.
3. Microbial fermentation for the production and estimation of ethanol.
4. Determination of the microbiological quality of milk sample by MBRT.
5. Isolation of fungi from spoilt bread/fruits/vegetables.
6. Preparation of yogurt.

**References:**

7. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi.
8. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education.
10. Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's Microbiology.9th Edition. McGraw Hill Higher education.
11. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
12. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
13. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
14. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
15. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
16. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.

**KAKATIYA UNIVERSITY**  
**B. Sc (CBCS) Microbiology – III Year**  
**SEMESTER – VI - C**  
**ENVIRONMENTAL MICROBIOLOGY**

**Practical's**

1. Determination of Biochemical Oxygen Demand (BOD) of sewage water
2. Determination of Chemical Oxygen Demand (COD) of industrial waste water
3. Bacteriological examination of water using multiple tube fermentation test: presumptive test, confirmed test and completed coli form test
4. Analysis of Air Microflora

**KAKATIYA UNIVERSITY**  
**B. Sc (CBCS) Microbiology – III Year**  
**SEMESTER – VI - C**  
**ENVIRONMENTAL MICROBIOLOGY**

**Theory syllabus**

**UNIT - I**

1. Aero microbiology: Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi).
2. Impact of air borne microorganisms on human health and environment.
3. Significance of air borne microorganisms in food and pharma industries and operation theatres, allergens.

**UNIT - II**

1. Air sample collection and analysis: Bioaerosol sampling, air samplers, methods of analysis, CFU.
2. Culture media for bacteria and fungi, Identification characteristics.
3. Control measures: Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration.

**UNIT - III**

1. Water Microbiology: Water borne pathogens.
2. Water borne diseases.
3. Microbiological analysis of water: Sample Collection, Treatment and safety of drinking (potable) water.

**UNIT - IV**

1. Methods to detect potability of water samples: Standard qualitative procedure: presumptive test(MPN test), confirmed and completed tests for faecal coliforms
2. Membrane filter technique and Presence/absence tests.
3. Control measures: Precipitation, chemical disinfection, filtration, high temperature, UV light.

**References:**

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

**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
**Under Graduate Courses (Under CBCS 2020 – 2021 onwards)**  
**B.Sc. MICROBIOLOGY II Year**  
**SEMESTER – IV**

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**MOLECULAR BIOLOGY AND MICROBIAL GENETICS PRACTICAL**  
**(PAPER – IV: Discipline Specific Course)**

**Practical: 3 Hours/Week Credits: 1 Marks: 25**

1. Estimation DNA by diphenylamine (DPA) method.
2. Estimation of RNA by orcinol method
3. Study of cell division in onion root tip (mitotic divisions)
4. Isolation of DNA from bacteria.
5. Isolation of mutants of bacteria by UV exposure.
6. Problems related to Mendilian laws mono and dihybrid cross (problems)
7. Problems related to gene interactions
8. Problems related to DNA and RNA characteristics, Transcription and Translation.

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**SEMESTER – IV**

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**MOLECULAR BIOLOGY AND MICROBIAL GENETICS**  
**(PAPER – IV: Discipline Specific Course)**

**Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)**  
**Practical: 3 Hours/Week Credits: 1 Marks: 25**

**UNIT – I**

1. Overview of prokaryotic and eukaryotic cells, cell size and shape, Eukaryotic and prokaryotic Cell organelles, Cell division (mitosis and Meiosis)
2. Fundamentals of genetics - Mendelian laws, alleles, crossing over, and linkage. DNA and RNA as genetic materials.
3. Structure of DNA – Watson and Crick model. Extrachromosomal genetic elements – Plasmids and transposons. Replication of DNA – Semiconservative mechanism.

**UNIT – II**

1. Brief account on horizontal gene transfer among bacteria – transformation, transduction and conjugation.
2. Mutations – spontaneous and induced, base pair changes, frameshifts, deletions, inversions, tandem duplications, insertions. Physical and chemical mutagens.
3. Outlines of DNA damage and repair mechanisms.

**UNIT – III**

1. Concept of gene – Muton, recon and cistron. One gene-one enzyme, one gene-one polypeptide, one gene-one product hypotheses.
2. Types of RNA and their functions. Outlines of RNA biosynthesis in prokaryotes.
3. Genetic code. Structure of ribosomes and a brief account of protein synthesis.

**UNIT – IV**

1. Types of genes – structural, constitutive, regulatory. Operon concept. Regulation of gene expression in bacteria – *lac* operon.
2. Basic principles of genetic engineering - restriction endonucleases, DNA polymerases and ligases, vectors. Outlines of gene cloning methods. Genomic and cDNA libraries.
3. General account on application of genetic engineering in industry, agriculture and medicine.

**References:**

1. Genes XI, Author- B. Lewin.
2. Principles of Genetics, Authors- Gardner, Simmons and Snustad.
3. Concepts of Genetics, Authors- Klug and Cummings.
4. Microbial Genetics, Authors- Freifelder.
5. Genetics, Authors- Arora and Sandhu.
6. Text of Microbiology, Authors- Ananthanarayanan and Paniker.

**KAKATIYA UNIVERSITY**  
**B. Sc (CBCS) Microbiology – III Year**  
**Semester-V – B (Discipline Specific Elective)**  
**INDUSTRIAL AND FOOD MICROBIOLOGY**

**Theory syllabus**

**UNIT – I**

1. Introduction to Industrial microbiology: Brief history and developments in industrial microbiology.
2. Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous.
3. Types of fermenters – laboratory, pilot-scale and production fermenters. Components of a typical continuously stirred tank bioreactor.

**UNIT - II**

1. Isolation of industrial strains and fermentation medium: Primary and secondary screening. Preservation and maintenance of industrial strains.
2. Ingredients used in fermentation medium - molasses, corn steep liquor, whey & yeast extract.
3. Microbial fermentation processes: Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

**UNIT - III**

1. Microbial production of industrial products - citric acid, ethanol and penicillin.
2. Food as a substrate for microbial growth: Intrinsic and extrinsic parameters that affect microbial growth in food.
3. Microbial spoilage of food - milk, egg, bread and canned foods.

**UNIT - IV**

1. Principles and methods of food preservation and food sanitation: Physical methods - high temperature, low temperature, irradiation, aseptic packaging. Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite.
2. Dairy products, probiotics and Food-borne Diseases: Fermented dairy products yogurt, acidophilus milk, kefir, dahi and cheese.
3. Probiotics definition, examples and benefits.



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**Under Graduate Courses (Under CBCS 2020–2021 onwards)**  
**B.Sc. MICROBIOLOGY II Year**  
**SEMESTER – III**

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**MEDICAL MICROBIOLOGY & BASICS OF IMMUNOLOGY**  
**(PAPER – III: Discipline Specific Course)**

**Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)**  
**Practical: 3 Hours/Week Credits: 1 Marks: 25**

**UNIT – I: MEDICAL BACTERIOLOGY**

1. History of Medical Microbiology. Normal flora of human body.
2. Host pathogen interactions. Bacterial toxins, virulence and attenuation. Antimicrobial resistance. Air-borne diseases –Tuberculosis. Food and water-borne diseases - Cholera, Typhoid.
3. Contact diseases - Syphilis, Gonorrhoea. General account of nosocomial infections.

**UNIT – II: MEDICAL VIROLOGY AND PARASITOLOGY**

1. Air borne diseases – Influenza. Food and water-borne diseases – Poliomyelitis, Amoebiasis.
2. Insect-borne diseases - Malaria, Dengue fever. Zoonotic diseases – Rabies
3. Viral diseases - Hepatitis B, HIV, SARS, MERS;

**UNIT-III: INTRODUCTION OF IMMUNOLOGY**

1. History of Immunology, Cells and Organs of the immune system – Primary and Secondary lymphoid organs. Function of B and T lymphocytes. Natural Killer cells, Polymorphonuclear cells.
2. Structure and Classification of Antigens, Factors affecting antigenicity. Antibodies: Basic structure, Types of properties and functions of immunoglobulins
3. Types of Immunity: Innate and Acquired Immunity, Humoral and cell-mediated immune response.

**UNIT-IV: IMMUNOLOGICAL DISORDERS AND AG-AB REACTIONS**

1. Types of hyper sensitivity reactions – Immediate and delayed. Systemic and Localized autoimmune disorders. Complement pathways - Classical and Alternative pathways.
2. Types of antigen-antibody reactions – Agglutinations, Precipitation, Neutralization, Blood groups.
3. Complement fixation Test. Labeled antibody based techniques – ELISA, RIA and immunofluorescence; Polyclonal and Monoclonal antibodies production and application.

**References:**

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
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood JM and Woelkeford CJ. (2013) Prescott, Harley and Klein's

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**B.Sc. MICROBIOLOGY II Year**  
**SEMESTER – III**

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**MEDICAL MICROBIOLOGY & BASICS OF IMMUNOLOGY PRACTICAL**  
**(PAPER – III: Discipline Specific Course)**

**Practical: 3 Hours/Week Credits: 1 Marks: 25**

1. Enumeration of RBC and WBC
2. Estimation of blood haemoglobin.
3. Determination of blood groups and Rh typing.
4. Isolation and identification of medically important bacteria by cultural, microscopic and biochemical tests.
5. Antibiotic sensitivity testing – disc diffusion method.
6. Parasites – Malarial parasite, *Entamoeba* (study of permanent slides).
7. Tests for disinfectant (Phenol coefficient).
8. Typing of human blood groups-slide agglutination
9. Estimation of hemoglobin content of human blood
10. Preparation of blood smear and different blood cell count
11. RBC count
12. WBC count
13. Differential staining of WBC by Leishman's stain
14. Widal-slide agglutination test
15. RPR card test for syphilis
16. Tridot test
17. Tube flocculation test

6. N.J. Dimmock, A.J Easton, and K.N. Leppard. Introduction to Modern Virology. Blackwell Publishing.

## II-Semester Practical Paper – II

Microbial Physiology and Biochemistry 2 HPW- CREDITS-1

### 5<sup>th</sup> Credit: Practicals

1. Setting up of Winogradsky's column
2. Cultivation of photosynthetic bacteria
3. Determination of viable count of bacteria
4. Turbidometric measurement of bacterial growth curve
5. Factors affecting bacterial growth – pH, temperature, salts
6. Qualitative tests for carbohydrates and amino acids
7. Determination of pH
8. Preparation of Buffers
9. Colorimetry - Principles, laws, determination of absorption maxima
10. Paper chromatography-separation of sugars/amino acids

### References:

1. Experiments in Microbiology by K.R. Aneja.
2. Gopal Reddy.M., Reddy. M.N., Sai Gopal, DVR and Mallaiah K.V. Laboratory Experiments in Microbiology.
3. Dubey, R.C. and Maheshwari, D.K. Practical Microbiology, S. Chand and Co New Delhi.
4. Alcamo, I.E. Laboratory Fundamentals of Microbiology. Jones and Bartlett Publishers, USA.
5. Mahy, B.W.J. and Kangro, H.O. Virology – Methods Manual Academic Press, USA.
6. Burleson et al Virology – A Laboratory Manual. Academic Press, USA.

**B.Sc I year: II Semester Paper-II Theory**

**Code: BS 204, DSC**

**Title: Microbial Physiology and Biochemistry**

**4HPW-credits-4**

**1<sup>st</sup> Credit: Microbial nutrition and growth**

Microbial Nutrition, Uptake of nutrients by cell. Nutritional groups of microorganisms – Autotrophs, Heterotrophs, Mixotrophs, Methylotrophs. Photosynthetic apparatus in prokaryotes.

Bacterial growth – Different phases of growth, factors influencing bacterial growth. Synchronous, Continuous, Biphasic Growth. Methods for measuring microbial growth – Direct Microscopic, Viable count, Turbidometry.

**2<sup>nd</sup> Credit: Microbial metabolism**

Bacterial photosynthesis: Outline of oxygenic and anoxygenic photosynthesis in bacteria. Microbial respiration – Aerobic: Glycolysis, HMP Pathway, ED Pathway, TCA Cycle and Anaplerotic reactions, Electron transport, Oxidative and Substrate level phosphorylation. Glyoxylate cycle, Anaerobic respiration (Nitrate and Sulphate).

**3<sup>rd</sup> Credit: Biomolecules**

Classification and characteristics of carbohydrates (Monosaccharides, disaccharides and polysaccharides). General characteristics of amino acids and proteins, fatty acids (saturated and unsaturated) and lipids (sphingo lipids, sterols and phospholipids). Structure of nitrogenous bases, nucleotides and nucleic acids.

Properties and Classification of enzymes. Biocatalysis – Induced fit and Lock & Key Model, Coenzymes, Co-factors. Factors effecting enzyme activity.

**4<sup>th</sup> Credit: Biochemical techniques**

Hydrogen ion concentration in biological fluids. pH measurement. Types of buffers and their uses in biological reactions. Principles and application of colorimetry and chromatography (paper and thin layer). Principles and applications of Electrophoretic techniques- Agarose gel electrophoresis and SDS PAGE

**References:**

1. Michael J. Pelczar, Jr. E.C.S.Chan, Noel R. Krieg Microbiology Tata McGraw- Hill Publisher.
2. Prescott, M.J., Harley, J.P. and Klein Microbiology 5<sup>th</sup> Edition, WCB Mc GrawHill, New York.
3. Madigan, M.T., Martinkl, J.M and Parker.j. Broch Biology of Microorganism, 9<sup>th</sup> Edition, MacMillan Press, England.
4. Dube, R.C. and Maheshwari, D.K. General Microbiology S Chand, New Delhi.
5. Voet, D Biochemistry WCB. Mc GrawHill, Iowa.