

Tribhuvan University
Institute of Science and Technology
Three year B. Sc. Microbiology course of study
2052

Course Title: General Microbiology	Full Marks: 100
Course No.: MB 311 (Major/Minor)	Pass Marks: 35
Nature of the Course: Theory	Year: I

Course Objectives (MB 311 & 312):

The main objective of the course are to give the students general knowledge and practical skill about

- the concept of the microbial world
- the nomenclature of microbiology
- the fundamental techniques of handling microbes and
- the characteristics physiology, genetics and ecology of microbes.

Chronological Development of Microbiology and Discovery: Introduction microorganisms as a cell, general history of microbiology and microorganisms, microbial diversity, discovery of microorganisms, spontaneous generation, germ theory of diseases. **11 hrs.**

Correlate Microbiology with Different Areas: Disciplines of microbiology, medical and public health microbiology, agricultural microbiology, food microbiology, microbial biotechnology, industrial and environmental microbiology. **15 hrs.**

Nomenclature of Microorganisms: Classification and nomenclature.

Physiology of Bacteria: Morphological characteristics and the fine structure of bacteria, nutrition, reproduction and cultivation.

Fungus: Fungi, Classification, structure, growth and reproduction, fungi of medical importance.

Introductory Parasitology: Protozoan: structure and reproduction; Nematodes: structure and its role in agriculture.

Introductory Knowledge about Virus: Structure, Classification and medical importance of virus. **19 hrs.**

Microbial Techniques: Types of microscope, types of culture medium, types of microorganisms including anaerobic bacteria. **6 hrs.**

Handling Microorganisms: Aseptic techniques during the handling of microorganisms, isolation and identification of microorganisms (bacteria, fungi and viruses), enumeration and counting of micro-organisms. **15 hrs.**

Methods of Sterilization: Principles of sterilization, control of micro-organisms by, temperature (high and low temperature), irradiation, ultrasonic, filtration, chemical agents. **19 hrs.**

Physiological Characteristics of Microorganisms: Growth of microorganisms (growth curve), factors affecting the growth of microorganism, essential nutrient including carbon, nitrogen, mineral and other sources of vitamin, temperature, water activity, salinity, pH, gases, CEC.

Biochemical Properties of Microorganisms: Nutritional types, photolithotrophic, chemolithotrophic,

photoorganotrophic, chemoorganotrophic, microbial energetic, carbon metabolism (general concept of glycolysis and TCA cycle), ATP generation, fermentative pathways. **29 hrs.**

Microbial Genetics: Introduction, prokaryotic genome, genetic code, plasmids, recombination of gene, mutation, auxotrophic mutation. **21 hrs.**

Ecological Factors in the Microbial World: Introduction, ecological concept, microbial interactions and symbiotic relationship, normal microbial flora of animals and plants, microbial flora of aquatic and terrestrial environment **12 hrs.**

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Course No.: MB 311. (Major/Minor)
Nature of the Course: Practical

Full Marks: 50
Pass Marks: 20
Year: I

To identify role of microscope and operate it scientifically: Introduction of microscope, types of microscope, use of microscope in microbiology, numerical aperture, resolving power. **3 hrs.**

Application of equipment in microbiology for sterilization: Structure and method of working of: hot air oven, autoclave, incubator, UV- safety hood, steam sterilizer. **3 hrs.**

To prepare and use different stains: Doner stain, Gram's stain, Methylene blue stain, Ziehl Neelson stain, Nigrosin stain. **6 hrs.**

To perform the biochemical tests and make use of them: Sugar fermentation, MR tests, VP test, catalase test, oxidase test, nitrate test, hydrolysis test, starch hydrolysis, fat hydrolysis, tryptophane hydrolysis. **6 hrs.**

To prepare various culture media: Basic media, synthetic media, differential media, enriched media, enrichment media. **3 hrs.**

To Identify the Bacteria: Methods and approach to identify the bacteria. **3 hrs.**

To obtain the pure culture: Growth and reproduction, plate culture, streaking plate, V tube technique, serial dilution method (pour plate technique, spread plate technique), quantitative estimation of growth. **3 hrs.**

To detect the factors affecting microbial growth: Temperature, atmospheric pressure, hydrogen ion concentration (pH), miscellaneous physical requirement i.e. light and salt. **3 hrs.**

To identify various medical and agriculture importance of fungal elements: Collection of sample, cultural techniques, identification. **6 hrs.**

To measure the bacterial growth: Determination of cells: breed method, counting chamber, proportional count method, plate count, membrane filter count, turbidity measurements. **3 hrs.**

To calculate the size of microorganisms: Micrometry technique. **3 hrs.**

To detect the oligodynamic effect of metal and the effect of U.V. light on bacterial growth: Effect of metal on bacterial growth, effect of U.V. light on growth. **3 hrs.**

To distinguish the growth characteristics of anaerobes: Anaerobic bacteria and growth characteristics, methods of cultivation. **3 hrs.**

Evaluation of antibiotics: Effects of antibiotics on bacteria growth. **3 hrs.**

Text Book (MB 101 & 102):

1. Brock, T.D., Smith, T.W., Modigram M.T., *The Biology of Microorganisms*, Prentice Hall, 1970,
2. Harold, J.B., *Microbiological Application: A Laboratory Manuals in general Microbiology*, W.C. Broom Com. Publishers, 1979.

Reference Books:

1. Atlas, R.N. *Microbiology: Fundamental and Applications*, McMillan Co., 1984.
2. Micheal, J.P., E.C.S. Chan N.R., Kriej, *Microbiology*, Tata McGraw Hill (5th Ed.), 1993.

Course Title: Microbial, Biochemistry
and Biotechnology

Course No.: MB 321 (Major/Minor)

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 35

Year: II

Course Objectives (MB 321 & 322):

The main objectives of this course are:

- to give the students basic knowledge and practical skills related to
- living cell and its functions
- macromolecules of livings
- concept of biotechnology and genetic engineering.

Living cell and understanding of its biochemical functions

introduction to biochemistry: Origin of biochemistry and its relationship with other sciences, biochemical explanation of living things, the elements of life, chemical elements present in living organisms, organic compounds found in living cells; Water: the solvent for life, Cell Biomembrane-structure and functions. **3 hrs.**

Macromolecules of living cells: Molecular components of micro-organisms; Carbohydrates: introduction, functions, classification, structure, important properties, Lipids: introduction, functions, classification, properties and reaction; Proteins, aminoacids and enzymes: name and functions, structure and properties; Nucleic acid, structure and definition, types of nucleic acids: synthesis of nucleic acids, functions of nucleic acids. **18 hrs.**

Methods genetics: Concept of exergonic and endergonic reactions, Heterotrophic and autotrophic metabolism, Role of ATP intermediary metabolism, Heterotrophic generation of ATP in various pathways, Lipid metabolism. **16 hrs.**

Microbial genetics: Different types of genetic materials, structure, transcription and translation, regulation of gene expression, genetic code. **20 hrs.**

Concept of biotechnology: Definition and history, Scope and importance, risk and hazards of biotechnology. **18 hrs.**

Fermentation process: Introduction, Solid state fermentation, submerged state fermentation, fermentation industries, beer, ethanol, acetic acids, fermentor designs. **14 hrs.**

Agricultural microbial biotechnology: Introduction, biofertilizer and composting, plant tissue culture micropagation and disease free plants, general concept of cell fusion and embryo transfer, mushroom culture. **8 hrs.**

Biotechnology in dairy industry: Cheese production, others milk products, sour milk, dry power milk. **10 hrs.**

Methods in genetic engineering: Introduction, technique of gene manipulation, outline of gene cloning, gene cloning procedure, achievement and prospect of genetic engineering. **12 hrs.**

Enzyme technology in various areas: Introduction, source of enzymes, selection of source of enzymes, advantage of microbial enzymes. **16 hrs.**

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Pass Marks: 20

Year: II

To Prepare the solution of different concentrations: Molar solutions, normal solutions, ppm (part per million) solutions. **3 hrs.**

To calculate the value of various solution: Measurement of pH by pH meter and indicators (papers); preparation of acetate, phosphate and citrate buffer of different pH. **3 hrs.**

To perform the qualitative and quantitative estimate of various types of carbohydrates: Benedict test (for reducing sugars), hydrolysis text (for di and polysaccharides), iodine text for starch, quantitative estimation of reducing sugar by DNS (3,5 dinitrosalicylic acid method). **3 hrs.**

To estimate the lipid types: Determination of the acid value of fat saponification value of fat, 'Me' iodine number of fat, estimation of blood cholesterol. **3 hrs.**

To estimate the protein: Ninhydrin reaction, biuret reaction, xanthoproteic reaction, caesin text in milk, test for tryrosine, tryptophan and arginine, test for sulphur containing amino acids, heat coagulation test for egg albumin, quantitative estimation of amino acids by using ninhydrin reactions. **3 hrs.**

To analyse the different enzymes qualities: Amylase, sucrose, carboxylase, protease, lipase, phosphatase, lactase. **3 hrs.**

To use the different instruments and techniques for biochemical analysis: Separation of amino acids by paper electrophoresis, identification of sugars by thin layer

chromatography (TLC), separation of lipid by thin layer chromatography (TLC), separation of amino acids by paper chromatography. **3 hrs.**

To detect the pathogenic and symbiotic micro organisms from various plants and their products: Diagnosis of citrus virus by ELISA, *Rhizobium* inoculation in different leguminous plants, production of potato seedling by tissue culture technique, isolation of mycorrhiza from different plants. **3 hrs.**

To apply fermentation technology: Isolation of methanogenic bacteria from rumen, study of fermentation yield by substrate variation method, food and beverage industries. **6 hrs.**

Text Book (MB 201 & 202):

1. Wood, E.J. and Rickering, W.R., *Introducing Biochemistry and Biotechnology*, ELB Publication (latest publication).

Reference Books:

1. Rao, K. Ragunatham, *Textbook of Biochemistry* (3rd Ed.), Prentice Hall of India, 1986.
2. Rao, R.A. v. SS. *A textbook of Biochemistry*, UBSPD Co. 1993.

Course Title: Agriculture and Food
Microbiology

Full Marks: 100

Course No.: MB 331 (Major)

Pass Marks: 35

Nature of the Course: Theory

Year: III

Course Objectives (MB 331 & 332):

The objectives of the course are:

- to give the students basic knowledge of theory and practical skills related to:
- different types of soil and their constituents
- the role of micro-organisms in soil fertility
- the role of various mineral cycles of nature
- various microbes found in different kinds of food.

Formation of soil: Physical factors, chemical factors, biological factors.

Soil and its constitutions: Mineral matters, organic matters, soil solution, gases. **8 hrs.**

Discrimination of micro-organisms and their roles: Bacteria, fungi, actinomycetes, protozoa, blue-green algae (cyanobacteria). **10 hrs.**

Rhizospheric and phyllospheric microorganisms: Introduction, role of crop production, factors influencing their growth and activities. **12 hrs.**

Role of different microorganisms: Introduction, Nitrogen cycle, ammonification, nitrification, denitrification, carbon cycle, organic matter decomposition, recycling of organic wastes, phosphorous solubilisation mineralization, inorganic phosphorous, organic phosphorus, sulphur cycle, mineralization, microbial assimilation of sulphur, oxidation of sulphur, reduction of inorganic sulphur compounds. **19 hrs.**

Anaerobic decomposition and mechanism of methane production and application: Anaerobic decomposition of organic compounds, mechanism of methane production, digested slurry as manure. **10 hrs.**

Micro-organisms in various foods: Bacteria, molds, yeasts, primary sources of micro-organisms in food contamination. **14 hrs.**

Techniques used for the determination of microorganisms in food: Techniques of demonstration of micro-organisms in food, sampling methods (various food industries, dairy market, meat market), culture. **10 hrs.**

Factors affecting the microbial growth (intrinsic and extrinsic): Intrinsic parameters, extrinsic parameters. **6 hrs.**

Food handling & spoilage: Different types of food handling in industries and market, spoilage of fruits and vegetables, fresh and processed meat and poultry product, egg and egg product, milk and milk products, canned foods, flour cereals and bakery products, fermented foods, soft drinks. **22 hrs.**

Food preservations: Chemical, irradiation, low temperature, high temperature, drying. **10 hrs.**

Foods quality, evaluation: Quality standard of milk, quality standard of bakeries, quality standard of meat and eggs, quality control of food. **10 hrs.**

Role of microorganisms in food poisoning: Gram positive cocci (*Staphylococcus* spp.) Germ positive spore formers (*Clostridium* spp.), Germ negative bacteria (*Salmonella* spp.) **10 hrs.**

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Microorganisms present in soil: Total viable number of bacteria, fungi, actinomycetes in different kinds of soil. **3 hrs**

Burried slide technique for microbial flora of soil: Different types of micro organisms in soil, identification of microbes by using various techniques. **3 hrs.**

Azotobacter: Introduction, morphological structure, culture of *Azotobactes*. **3 hrs.**

Rhizobium: Morphological structure, cultural properties, methods of isolation and identification. **3 hrs.**

Cellulolysis produced by organisms: Demonstration of cellulolysis, use of cellulolysis. **3 hrs.**

Micro organisms from Biofertilizers: Isolation and identification of organisms responsible for formation of fertilizers. **3 hrs.**

Distinction of various organisms present in soil: Demonstration of Winogradsky's column, uses of column in differentiation of microbial ecology. **6 hrs.**

Discrimination of various organisms from soil samples: To show the distribution of organisms, their methods of isolation and antibiotic activity. **3 hrs.**

Cyanobacterial: Isolation, growth characteristics, identification. **3 hrs.**

Count of micro-organism in different foods: Methods of isolation and counting technique of bacteria from various foods. **3 hrs.**

Dairy products Milk, cheese & ice-cream: Culture of organism, detection and demonstration of micro organisms. **3 hrs.**

Reduction test in milk: MBRT test **3 hrs.**

Presence of microorganisms in meat and meat products: Isolation and identification of types of organism in meat and meat products. **3 hrs.**

Microorganisms present in fruits: Culture of micro organism in fruits (their types), methods of identification. **3 hrs.**

Text Books (MB 331 & 332)

1. Jay, J.H., *Modern Food Microbiology* (3rd Ed.) CBS. Pub. & Distributors, Delhi, 1987.
2. Martin Alexander, *Introduction to Soil Microbiology*, Academic Press, 1961.

Reference Books:

1. Rangaswami, G., Bagyaraj, P.T., *Agricultural Microbiology* (2nd Ed.), Prentice Hall of India, 1993.

Course Title: Medical and Environmental
Microbiology

Full Marks: 100

Course No.: MB 333 (Major)

Pass Marks: 35

Nature of the Course: Theory

Year: III

Course Objectives (MB 333 & 334):

The main objectives of the course is to give knowledge on:

- the Microbial world in the human body
- the methods of transmission of microbes
- the process of immunizations and laboratory biosafety
- microbes and its environments

Historical background of medical microbiology: Historical aspect of medical microbiology and various diseases process. **4 hrs.**

Bacterial flora of the human body: Study of microorganisms from skin gastrointestinal tract, respiratory tract, commensals, symbiotic, opportunistic. **10 hrs.**

Method of transmission of diseases: Explanation of: epidemic, endemic, pandemic. **8 hrs.**

Types of infection: Mechanism of infection, host-parasite-interaction. **6 hrs.**

Immunity process: Types of immunity, immunoglobulins and their types, antigen-antibody reaction, auto-immune disease, hyper-sensitivity, acquired immune deficiency syndrome (AIDS). **27 hrs.**

Safety measures in clinical laboratory: Principles of laboratories safety, decontamination and disposal of infected materials. **4 hrs.**

Importance of antibiotic and chemotherapeutic agents in clinical Microbiology: Types of antibiotics, chemotherapeutic agents, mode of actions. **6 hrs.**

Methods of specimen collection, transportation of medical samples or specimen: Cerebrospinal fluid, blood sputum, urine and other body fluids, discharges and Pus. **6 hrs.**

Method of collections of viral samples: Introduction, types of viral samples, maintenance of temperature and transportation, identification and interpretation. **6 hrs.**

Common pathogenic viruses: Mumps, measles, polio, influenza, rabies, human immune deficiency virus, viral culture. **8 hrs.**

Sample collection and lab diagnosis of nicotinic infections: Samples, nasal Swab, skin scraping, other samples. **9 hrs.**

Medically important fungi: Introduction, classification, morphology, basis of growth. **9 hrs.**

Microbial ecology: Microbial association of soil, water and air. **6 hrs.**

Aquatic microbiology: Introduction, types of water, characteristics of water. **6 hrs.**

The water quality basis: Water quality criteria, source of water pollution, water control, water treatment, control of water-borne diseases. **12 hrs.**

Industrial effluent: Introduction, industrial pollution, domestic sewage and microbiology of sewage, methods for the treatment of industrial effluent and sewage. **12 hrs.**

Microbial air pollution: Introduction, methods of measuring microorganisms in air (indoor and out door), air-borne diseases, air-pollution control. **9 hrs.**

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Course No.: MB 334 (Major)

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Full Marks: 50

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To interpret safety precautions in medical micro biological laboratories: Demonstrate the of precautions to be taken in the laboratories. **3 hrs.**

To prepare the reagents for staining: Preparation of reagents for staining Gram's staining, Ziehl Neelson, Albert stain. **3 hrs.**

To illustrate different staining procedure: Gram's staining, etc. **3 hrs.**

To categories different cultural media: Preparation of media, nutrient agar, blood agar, Mac Conkey agar. **3 hrs.**

To illustrate the inoculation and biochemical tests of bacterial culture: MR test, VP test, citrate test, urease test, SIM test, indole test. **3 hrs.**

To discriminate different types of bacteria from biochemical tests: Sugar test, nitrogen test, interpretation of the result after biochemical test. **6 hrs.**

To operate enzymatic test of the bacteria: To perform important enzymatic tests, coagulase test, catalase test, oxidase test. **6 hrs.**

To explain serological test on virus: ELISA test, hemagglutination test. **3 hrs.**

To operate Nicotinic infection samples: Sample collection, skin scrapping, nail clipping, sputum. **6 hrs.**

To examine the fungal elements: Detection of fungal elements:, KOH preparation, Iodine preparation, India ink preparation, lactophenol and cotton blue preparation. **6 hrs.**

To predict fungal culture media: Perparation of mediasabouraud dextrose agar, potato dextrose agar, malt extract agar. **6 hrs.**

To operate bacteriological examination of drinking water: MPN methods, MF methods. **6 hrs.**

To predict microbial and biochemical parameters of sewage: Perform microbial count, DO and BOD test. **6 hrs.**

To demonstrate water treatment station: Field visit to water treatment station. **3 hrs.**

To categorize the types of air pollution: Study microbes in air class room, laboratory, public house, factories, etc. **9 hrs.**

Text Book, (MB 333 & 334):

1. Monica Chusbrough, *Medical Laboratory Manual for Tropical Countries Vol.2*, ELBS London, 1984.
2. Michael J.P., E.C.S. Chan and N.R. Krieg, *Microbiology*, The Edition Tata McGraw Hill New Delhi, 1993.

Reference Book:

1. Grewwood, D., Slack, R.C.B., Peutherer, J.F., *Medical Microbiology*, ELBS. With Dunciude Livingstone.