

RANI DURGA VATI VISHWA VIDYALAYA, JABALPUR
SYLLABUS PRESCRIBED FOR THE
DEGREE OF THE BACHELOR OF SCIENCE
(From 2011-12 onwards)
B.SC FIRST SEMESTER
MICROBIOLOGY
Paper- General Microbiology

(MM Theory 70 + CCE 30)

UNIT I

Introduction to Microbiology:

History; Spontaneous generation conflicts; Germ theory of disease; Development in medical microbiology; Development in non-medical microbiology- soil and agriculture microbiology, food and industrial microbiology, molecular biology; Scope of microbiology; Applications of microbiology in human welfare; Development of microbiology in India and abroad: Contributions of Antony van Leeuwenhoek, Alexander Fleming, Edward Jenner, Louis Pasteur, Robert Koch, Salmen Waksman, Joseph Lister, M.S. Swaminathan, G.P. Talwar, T.S. Sadasivan, C.V. Subramaniyam and R. N. Singh in microbiology.

UNIT II

Diversity of Microbial World A:

Classification; General characteristics and structure of Bacteria (Eubacteria and Archaeobacteria); Morphology of bacteria; Ultrastructure of bacterial cell; Surface appendages- flagella, pilli, prosthecae and stalk; Surface layers of bacteria- sheath, glycocalyx and cell wall; Internal cell structures- cell membrane; Internal membrane system- Mesosomes and Gas vacuoles; Cytoplasmic matrix- Ribosomes, Nucleoid and cytoplasmic inclusions, Dormant structures- Exospores, Cysts and Endospores (sporulation and germination); Cyanobacteria; Actinomycetes; Mycoplasma; Rickettsia and Chlamydia with emphasis on function of each part components.

UNIT III

Diversity of Microbial World A:

Classification: Brief introduction to classes of fungi; General characteristics: thallus, mycelial modification, nutrition, heterokaryosis, structure with emphasis on function of each part and components of cell; Reproduction: sexual and asexual reproduction; Economic importance of fungi.

Diversity of Microbial World B:

Classification; General characteristics; Morphology and structure: Morphological groups of phages, phage structure, phage nucleic acids; Virus host; General features of virus reproduction: Lytic and lysogenic cycle and their mechanism; DNA and RNA viruses: T4, TMV, Pox virus, Prions, Virions, Virusoid and Virioids.

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1. Board of Studies in Microbiology on 16/07/11 & Faculty of Life Science on 16/07/11

UNIT IV

Microbiological Methods:

Medium optimization: Nutrient, Characteristics of growth medium, Types of media; Preparation of media; Sterilization- definition, Principle, Conditions influencing antimicrobial action; Mode of action of antimicrobial agents; Physical Agents: High temperature- Thermal death time and Decimal reduction time; Applications of high temperatures for Destruction of Microorganisms- Moist heat, Boiling water Pasteurization, Dry-heat, Incineration; Low Temperatures, Desiccation- Lyophilization, Osmotic Pressure- plasmolysis and plasmoptysis, Radiation- Ultraviolet light, X-rays, Gamma rays, Cathode rays.

Chemical Agents: Characteristics of an ideal antimicrobial chemical agent; Sterilization, Disinfectant, Antiseptic, Sanitizer, Germicide (Microbicide), Bactericide, Bacteriostasis, Antimicrobial agent; Criteria for selection of chemical agent for practical applications; Major groups of chemical antimicrobial agents and their mode of action.

UNIT V

Isolation and maintenance of Microorganisms:

Pure, axenic, mixed culture, strain, isolate, clone- Definitions; Pure culture techniques: Dilution, Plating- pour plate method, spread plate method, streak plate method; Enrichment culture and micromanipulator, Maintenance and preservation of pure cultures: subculturing, overlaying, cultures with mineral oils, lyophilization, sand cultures, storage at low temperature; Major Microbial Culture Collection Centers in India.

List of Practicals (MM: 50)

1. Precautions to work in microbiology laboratory.
2. Basic media preparation, autoclaving, cleaning and sterilization of glasswares.
3. Media preparation Liquid media – Peptone water, Nutrient broth. Solid media – Nutrient agar (Agar slant, Agar plate) Enriched Medium – Blood agar, Differential medium – MacConkey agar, Enrichment Medium – Selenite F broth, Selective medium – EMB
4. Culture characteristics of Microorganisms on different media.
5. Demonstration of selective and differential media.
6. Isolation of bacteria from air, water and soil by serial dilution agar plating method
7. Isolation of fungi from air, water and soil by serial dilution agar plating method
8. Isolation of bacteria by pour plate method.
9. Isolation of bacteria by streak plate method.
10. Isolation of bacteria by spread plate method.

List of recommended books:

1. Microbiology, Authors- Pelczar, Chan and Kreig.
2. General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter
3. Biology of Microorganisms, Authors- Brock and Madigan.
4. Fundamental Principles of Bacteriology, Author- A.J. Salle.
5. Introduction to Microbiology, Authors- Ingraham and Ingraham.
6. Microbial Physiology, Authors- Moat and Foster.
7. Tools and techniques in microbiology by Nath and Upadhyay
8. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.II; Himalaya Publishing House.
9. Dubey R. C. and D. K. Maheshwari (2004). A Text book of microbiology, 1st Edition; S.Chand and Company Ltd.
10. H.C. Dube (2005) A Textbook of Fungi, Vikas Publishing House.

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1. Board of Studies in Microbiology on 16/07/11 & Faculty of Life Science on 16/07/11

**B.Sc. SECOND SEMESTER
MICROBIOLOGY
Paper- Tools and Techniques in Microbiology**

(MM Theory 70 + CCE 30)

UNIT I

Microscopy:

Invention of Microscope; History; Light Microscopy: Principle, Construction; Theory and applications of Bright Field Microscopy (Simple and Compound); Dark Field Microscopy; Phase Contrast Microscopy; UV and Fluorescent Microscopy; Electron Microscopy: Types of Electron Microscope (TEM & SEM); Preparation of Specimen, Advantages, Limitations and Applications; Use of Software in Microscopy.

UNIT II

Instrumentation Techniques

Basic principle, construction and applications of Autoclave, Oven, Incubator, BOD, Laminar Air Flow, Colorimetry and Spectrophotometer; Centrifugation: Basic principles of sedimentation, methods and applications; Chromatography: General introduction, definition and types of chromatography, General principles underlying chromatographic technique, Working and applications of Thin Layer Chromatography.

UNIT III

Micrometry and Staining

Ocular and Stage Micrometry: principle and application; Cell Count: Haemocytometry- principle and applications, Use of Camera Lucida; Stains and Staining Techniques: Necessity of staining, Chemistry of dyes and stains, Fixation of Smears, Mordents and Intensifiers, Decolorizers; Theory of Staining: physical and chemicals; Types of Staining: Simple staining, Negative staining, Differential staining, Flagella, Cell-wall, Gram staining, Acid Fast staining.

UNIT IV

Immunological Techniques

Zone phenomenon (Lattice hypothesis); Characteristics of Serological reactions; Neutralization, Precipitation: ring test, slide test and tube test, Agglutination: widal test, passive agglutination, Hemagglutination, Bacterial agglutination, Agglutination inhibition, Flocculation and Complement Fixation; Principle and applications of Radial immunodiffusion, Double immunodiffusion and Radioimmunoassay (RIA), Immuno-electrophoresis.

UNIT V

Biostatistics and Bioinformatics

Principle of Biostatistics; Classification of Data; Tabulation and Graphical representation; Measure of Central Tendency: Mean, Mode, Median- merits and demerits; Measure of Dispersion Range; Mean Deviation Variance and Standard Deviation.

Bioinformatics: Basic Organization of Computer; Computer Hardware; Software, Bit, Byte, Computer Memory, Binary Code, Binary System; Introduction to Bioinformatics, Database and applications of Bioinformatics.

List of Practicals (MM: 50)

1. Write the principle and components of Bright field compound microscope.
2. Write the principle and use of dissecting microscope.
3. Demonstration of principles and working of basic instruments: autoclave, incubator, hot air oven, pH meter, laminar air flow, spectrophotometer and centrifuge.
4. Preparation of smear and microscopic examinations of Fungi – *Mucor* spp., *Aspergillus* spp., *Penicillium* spp. & *Alternaria* spp. Bacteria – *Staphylococcus* spp. *Lactobacillus* spp. *Escherichia* spp. *Vibrio* spp. & *Leptospira* spp.
5. Staining techniques – Simple staining, Differential staining (Gram's, Ziehl-Neelsen), Spore and Capsular staining methods
6. Blood collection and plasma/serum separation.
7. Blood grouping – Rh typing – cross matching.
8. Agglutination reaction: Widal test
9. Paper and Thin layer chromatography.
10. SDS-PAGE electrophoresis.

List of recommended books:

1. Microbiology, Authors- Pelczar, Chan and Kreig.
2. General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter
3. Biology of Microorganisms, Authors- Brock and Madigan.
4. Fundamental Principles of Bacteriology, Author- A.J. Salle.
5. Introduction to Microbiology, Authors- Ingraham and Ingraham.
6. Microbial Physiology, Authors- Moat and Foster.
7. Tools and techniques in microbiology by Nath and Upadhyay
8. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.II; Himalaya Publishing House.
9. Dubey R. C. and D. K. Maheshwari (2004). A Text book of microbiology, 1st Edition; S.Chand and Company Ltd.
10. H.C. Dube (2005) A Textbook of Fungi, Vikas Publishing House.

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1. Board of Studies in Microbiology on 16/07/11 & Faculty of Life Science on 16/07/11

**B.Sc. THIRD SEMESTER
MICROBIOLOGY
Basic Biochemistry**

(MM Theory 70 + CCE 30)

UNIT I

Basic Building Blocks

Biochemistry as molecular logic of living being; Axioms of living matter; Major organic compounds of animate objects- a general view.

Chemical elements, Structure of atoms; Molecular and Chemical Bonds: Ionic, Covalent, Coordinate and Hydrogen bonds; Structure, function and properties of Water, Water as universal solvents; Acids, Bases, Salts, pH and Buffers.

UNIT II

Carbohydrates

Definition, Classification of Carbohydrates; Chemical structure and properties of Monosaccharide, Disaccharides, Oligosaccharides and Polysaccharides; Starch, Cellulose and Glycogen.

Purines and Pyrimidines: Structure and properties.

UNIT III

Proteins

Definition, structure and classification of Amino acids, essential and non essential amino acid, Acid-base properties and solubilities, Amino acid sequencing of proteins; Sanger and Edman's method: Structure, properties and functions of primary, secondary and tertiary proteins.

UNIT IV

Lipids

Definition, Classification and properties of lipids; Saturated and Unsaturated Fatty Acids and their role and functions in microorganisms; structure and properties of waxes, steroids, lipo-proteins and lipo-polysaccharides

UNIT V

Enzymology

Definition, structure and properties of enzymes, Classification of enzymes; Co-enzymes and Co-factors; Introduction to Active site and Enzyme specificity; Factors affecting the enzyme action: temperature, pH, activators, substrates; Enzyme-substrate interaction: Fisher lock-key hypothesis and Koshland induced fit hypothesis.

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List of Practicals (MM: 50)

1. To determine the pH of a given solution.
2. To prepare a buffer solution.
3. Identification of biological compound, Carbohydrates - Molisch's test, Protein - Biuret test, Lipid - Saponification test
4. Qualitative analysis for amino acid- Color reaction for amino acid, Biuret test, Ninhydrine test.
5. Quantitative analysis of fat- Test for oil, Solubility test, Emulsion test, Absorption test.
6. Estimation of glucose by Cole's method
7. Detection of water alkalinity and acidity.
8. To find out normality of acid with alkali.
9. To find out normality of alkali with acid.
10. Estimation of protein by Folin Lowry method.
11. Estimation of total lipid by dichromate method.

List of recommended books:

1. Principles of Biochemistry, Author- A.L. Lehninger
2. Fundamentals of Biochemistry, Author- J. L. Jain
3. Biochemistry, Author- Voet and Voet.
4. Microbial Genetics, Authors- Freifelder.
5. Textbook of Microbiology, Authors- Dubey and Maheshwari.
6. Powar C. B. and G. R. Chatwal (1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.
7. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.I; Himalaya Publishing House
8. Jain, J.L., S. Jain and N. Jain (2005) 6th Edition. Fundamental of Biochemistry. S. Chand and Co.
9. Rama Rao, A.V.S.S. (2000) 8th Edition. Textbook of Biochemistry. UBS Publ

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**B.Sc. FOURTH SEMESTER
MICROBIOLOGY
Microbial Physiology and Metabolism**

(MM Theory 70 + CCE 30)

Unit I

Utilization of Energy:

Microbial biosynthesis; methods of studying microbial biosynthesis; assimilation of Ammonia, Nitrogen and Sulphate

Utilization of energy in non-biosynthetic and biosynthetic process: Bacterial motility- flagellar and gliding. Diffusion: gaseous exchange, osmosis, plasmolysis transport of nutrients in bacteria- active transport, passive diffusion, facilitated diffusion, group translocation, Biochemical properties of membranes.

Unit II

Energy production in Anaerobic and Aerobic process:

Glycolysis; Pentose phosphate pathway; Entner Duodoroff pathway; fermentation; glucose fermentation by *E.coli*; TCA cycle; heterotrophic carbondioxide fixation; Glyoxylate cycle; catabolism of lipids: α and β -oxidation; catabolism of proteins; Aerobic respiration

Unit III

Bioenergetics

Principles of Bioenergetics; ΔG , endergonic and exergonic reactions; oxidation-reduction reaction; Redox-potential; oxidative phosphorylation: hypothesis; inhibitors of oxidative phosphorylation

Unit IV

Growth and Growth Measurement

Definition of growth; mathematical expression of growth; growth curve; growth yield; factors affecting growth; nutrient, temperature, oxygen, pH, osmotic pressure; Measurement of growth by measuring cell number, cell mass and cell activity, Cell count- direct and indirect method, dry weight and wet weight method; synchronous culture; continuous culture; and batch culture.

Unit V

Energy production by photosynthesis and microbial metabolism fueling reaction

Definition of bacterial and cyanobacterial photosynthesis; antenna of light harvesting pigments; photochemical reaction; cyclic and non cyclic photophosphorylation; role of ATP in metabolism; role of reducing power in metabolism; role of precursors of metabolism; component of Electron transport chain and arrangement of ETC in cell membrane

List of Practicals (MM: 50)

1. Enumeration of bacterial colony using colony counter.
2. Enumeration (counting) of bacteria by plate count or serial dilution agar plate technique.
3. Demonstration of O₂ evolution during photosynthesis.
4. Determination of bacterial growth by turbidity measurement (spectrophotometric method).
5. Effect of temperature on bacterial growth (TDP & TDT).
6. Effect of pH on bacterial growth.
7. Effect of osmotic pressure (salt and sugar concentration) on bacterial growth.
8. Determination of fungal growth by mycelia weight determination method.
9. Demonstration of active and passive transport mechanism.
10. Study of bacterial growth curve.

List of recommended books:

1. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.II; Himalaya Publishing House
2. Tortora G.J., B.R. Funke and C.L. Case, 5th edition. Microbiology: An Introduction. The Benjamin/ Cummings Publishing Co., Inc.
3. Powar C.B. Cell Biology.
4. Madigan M. T., J.M. Martinko and J. Parker, 9th edition. Brock's Biology of Microorganisms. Prentice Hall
5. Talaro K. and A. Talaro Foundations in Microbiology. Wm. C. Brown Publishers.
6. Murray R. K., D. K. Granner, P.A. Mayes and V.W. Rodwell (2003) 26th edition. Harper's Illustrated Biochemistry.
7. Moat and Foster. Physiology and Metabolism.
8. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.
9. Davis. Immuno.

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**B.Sc. FIFTH SEMESTER
MICROBIOLOGY
Paper- Molecular Biology & Microbial Genetics**

(MM Theory 70 + CCE 30)

UNIT I

Genetic Material

Nucleic acid as genetic material, Evidence; Physical and chemical structure of DNA;- Watson & Crick model (B-form, Z-form, D-form); Nature of gene structure and functions; Melting curve of DNA and T_m value determination; Buoyant density of DNA and its relationship with mole (G+C) content in DNA; Types of RNA: mRNA, rRNA, tRNA; Organization of Eukaryotic chromosome and mechanism.

UNIT II

DNA Replication

Types of DNA replication: Conservative, Semi-conservative and Dispersive mode of replication; Mechanism of replication, Messelson and Stahl experiment; DNA topology: Supercoiling of DNA and linking number Enzymes involved in replication of DNA; Replication of DNA in prokaryotes and eukaryotes; Molecular Mechanism of Chromosomal replication, Models of chromosomal replication- Cairns model, Rolling Circle model; Future practical applications.

UNIT III

Transcription

Enzymatic synthesis of RNA; Transcription signals; Mechanism of transcription in prokaryotes and eukaryotes; Post transcriptional modification- basic concepts.

UNIT IV

Translation and Gene regulation

Outline of translation; Requirements of translation; Genetic Code: Basic features of genetic code- Biological significance of degeneracy, Wobble hypothesis, Poly cistronic RNA, Overlapping genes, deciphering of genetic code; gene translocation, Ribosomes: their general nature and role in protein synthesis, charging of tRNAs, initiation, elongation and termination of protein synthesis in prokaryotes; post translational modification of polypeptides; regulation of protein synthesis; Lac operon.

UNIT V

DNA mutation and repair

Types of mutation; evidence of spontaneous nature of mutation: fluctuation test, new comb's experiment and replica testing; mode of action of physical, chemical and biological mutagens-UV rays, nitrous acid, 5-bromouracil, 2-aminopurine, EMS. Reversion in mutation, true reversion, suppression and types of suppressor mutation; DNA repair mechanism, Photo reactivation, Excision, Mismatch, SOS repair and Dealkylation repair

List of Practicals (MM: 50)

1. Demonstration on isolation of DNA.
2. Demonstration of agarose gel electrophoresis.
3. To study qualitative estimation of DNA by gel electrophoresis.
4. Quantitative estimation of DNA by DPA method.
5. Quantitative estimation of RNA by Orcinol method.
6. To study conjugation in bacteria.
7. To transfer bacterial colonies by replica plating method.
8. Effect of UV light on growth of bacteria.
9. Effect of mutagen on the growth of bacteria.
10. To study antibiotic resistance in bacteria.

List of recommended books:

1. Principles of Biochemistry, Author- A.L. Lehninger
2. Fundamentals of Biochemistry, Author- J. L. Jain
3. Biochemistry, Author- Voet and Voet.
4. Microbial Genetics, Authors- Freifelder.
5. Textbook of Microbiology, Authors- Dubey and Maheshwari.
6. Powar C. B. and G. R. Chatwal(1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.
7. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.I; Himalaya Publishing House
8. Jain, J.L., S. Jain and N. Jain (2005) 6th Edition. Fundamental of Biochemistry. S. Chand and Co.
9. Rama Rao, A.V.S.S. (2000) 8th Edition. Textbook of Biochemistry. UBS Publisher Ltd.

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**B.Sc. SIXTH SEMESTER
MICROBIOLOGY
Paper- Applied Microbiology**

(MM Theory 70 + CCE 30)

UNIT I

Environmental Microbiology

Concept of environment in relation to microbes; Environment included physiological adaptation in microbes; Nature of microbial population in soil, water and air. Microbial interaction: Neutralism, Commensalism, Synergism. Liquid waste disposal, characteristics of solid and liquid waste; Sewage treatment: Primary, Secondary and tertiary treatment.

UNIT II

Agriculture Microbiology

Physical and chemical characteristics of soil, soil microflora. Soil fertility and management of agricultural soil, Rhizosphere and Phyllosphere; Microbial diseases of crop plants with special reference to wheat, rice. VAM and its importance. Nitrogen fixation by symbiotic and non-symbiotic microbes, use of microbes as biofertilizers, mass cultivation of *Rhizobium* and *Azotobacter*, use of Blue Green Algae as biofertilizer.

UNIT III

Industrial Microbiology

Fermentation- Definition, equipments and production process; Industrial production of alcohol and acetic acid, enzymes (amylase) Microbes as source of microbial and single cell proteins (SCP) and its production and applications.

UNIT IV

Food Microbiology

Food spoilage: Physical and microbial spoilage of food and food products, spoilage of stored products, fruits and vegetables, microbial spoilage of milk, milk products and meat. Food born diseases. Food preservation methods, asepsis, pasteurization, canning, desiccation, low temperature, anaerobiosis, filtration, chemical preservation of food- salt and sugar, organic acids, use of sulphur dioxide, ethylene and propylene oxides, wood smoke.

UNIT V

Medical Microbiology

Host microbe interaction, Mechanism of pathogenicity. Laboratory strategies in diagnosis of infective syndrome; Bacterial diseases of human: TB, Pneumoniae, Plague; Viral diseases of human: Syphilis, Pox, Hepatitis; Fungal diseases of human: Cryptococcosis, Candidiasis, Dermatomycosis; Sexually Transmitted Diseases (STDs).

List of Practicals (MM: 50)

1. Isolation of microorganisms from air.
2. Isolation of microorganisms from water.
3. Isolation of microorganisms from soil.
4. Total count of bacteria from water.
5. Measurement and confirmation of *E.coli* in water sample.
6. Isolation and identification of bacteria from spoiled food.
7. Study of rhizobium bacteria from root nodules.
8. Study of symbiotic and non-symbiotic blue green algae.
9. Blood examination for Rh factor.
10. Determination of milk quality by resazurin test.

List of recommended books:

1. Soil microbiology by Subba Rao
2. Food microbiology by James M.J
3. Dairy microbiology by Parihar and Parihar
4. Introductory food microbiology by H.A Modi
5. Soil and microbes by Waksman and Starkey.
6. Plant pathology by Mehrotra.
7. Alexander, M. Introduction to Soil Microbiology, 3rd Edition. Wiley Eastern Ltd., New Delhi
8. Food Microbiology by Frazier.
9. Microbiology by S.S. Purohit.
10. Industrial Microbiology by A.H Patel
11. Industrial Microbiology by L.S Casida

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