

DEPARTMENT OF MICROBIOLOGY
MATA GUJRI MAHILA MAHAVIDYALAYA (AUTONOMOUS) JABALPUR
SYLLABUS PRESCRIBED FOR THE DEGREE OF BACHELOR OF SCIENCE
Syllabus approved by Central Board of Studies in Microbiology
Department of Higher Education, Madhya Pradesh, Bhopal

B.Sc. FIRST YEAR – MICROBIOLOGY
Paper - I General Microbiology and Cell Biology

MM-40

UNIT – I

Introduction to Microbiology, History, Scope and development of Microbiology, Branches of Microbiology, Taxonomic position of microorganisms, Concept of diseases, Contributions of eminent Microbiologist of India and abroad, Applications of Microbiology in human welfare.

UNIT – II

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

UNIT – III

Classification of fungi, general characteristics, thallus, mycelia modification, nutrition, heterokaryosis, structure with emphasis on function of each part and components of cell, Sexual and asexual reproduction, Economic importance of fungi.

Classification, general characteristics, morphology and structure of phages, 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 Viriod.

UNIT – IV

Structural organization and function of cell organelles, Cell cycle, Cell division, Membrane structure and intercellular transport, cell locomotion, cellular interaction, cell differentiation and senescence.

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 culture; Subculturing, Overlaying culture with mineral oils, Lyophilization, Sand cultures, Storage at low temperature. Major Microbial Culture Collection Centres in India.

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B.Sc. FIRST YEAR – MICROBIOLOGY
Paper- II Tools and Techniques in Microbiology

MM-40

UNIT I

Principle and working of Bright Field Microscopy, 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 of Microscopy, Use of software in Microscopy.

UNIT II

Instrumentation Techniques, basic principle, function and applications of Autoclave, Oven, BOD Incubator, Laminar Air Flow, Colorimeter, Spectrophotometer, Centrifugation, Basic principles of Sedimentation, methods and applications, Chromatography, types of chromatography and applications of chromatography.

UNIT III

Ocular and stage micrometry, Cell count, Haemocytometry, Use of Camera Lucida, Stains and Staining techniques- Chemistry of dyes and stains, Fixation, Smears, Types of staining- Monochrome, negative staining, Differential staining- Gram Staining and Acid Fast Staining, Cell Wall Staining, Metachromatic Granule Staining, Capsule Staining.

UNIT IV

Types of media, Preparation of media, Characteristics of growth medium, Sterilization, Mode of action of antimicrobial agents, Physical agents, 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, disinfectant, antiseptic, sanitizer, germicide, 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

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, χ^2 (Chi square), t-test and F-test.

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 based on paper I and II for B.Sc. I Year (MM 50)

Teachers should give instruction to students to take necessary precautions while working in Microbiology Laboratory.

1. Demonstration and briefing about principles and working of basic instruments, autoclave, incubator, hot air oven, pH meter, laminar air flow, spectrophotometer and centrifuge.
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- Mac Conkey agar, Enrichment Medium- Selenite F Broth, Selective medium- EMB.
4. Cultural characteristics of Microorganisms on different media.
5. Demonstration of Selective and Differential Media.
6. Isolation of bacteria from water and soil by serial dilution agar plating method.
7. Isolation of Fungi from water and soil by serial dilution agar plating method.
8. Estimation of air microflora.
9. Isolation of bacteria by pour plate method.
10. Isolation of bacteria by Streak plate method.
11. Isolation of bacteria by spread plate method.
12. Preparation of smear and microscopic examination of fungi- *Mucor spp*, *Aspergillus spp.*, *Penicillium spp* & *Alternaria spp*. Bacteria- *Staphylococcus spp*, *Lactobacillus spp*, *Escherichia spp*, *Vibrio spp* & *Leptospira spp*.
13. Staining Techniques- Simple staining, Differential staining (Gram's, Ziehl Neelson), Spore and Capsular staining methods
14. Designing of at least two innovative experiments based on the available facility in the College / University related to the subject.

LIST OF SUGGESTD BOOKS:

- Microbiology-Pelczar MJ, Chan ECS & Kreig NR, 5th edition(Tata McGraw-Hill, NewDelhi)
- Fundamentals of Microbiology- Frobisher M, Hinsdill RD, Crabtree KT & Goodheart CR, 9th edition(W.B.Saunders Co.)
- Fundamental Principles of Bacteriology- Salle AJ, 7th edition(Tata McGraw-Hill, NewDelhi)
- Microbiology-Prescott LM, Harley JP & Klein DA, 7th edition(Wm. C. Brown Publishers, USA)
- Elementary Microbiology-Modi, HA(Vol.I), 1st edition(Ekta Prakashan, Nadiad)
- A Handbook of Elementary Microbiology- Modi HA,1st edition(Shanti Prakashan, Rohtak)
- A Textbook of Microbiology- Dubey RC& Maheshwari DK,2nd edition(S Chand& Co. N.Delhi)
- General Microbiology (Vol. I, II, III)-Powar CB, Dagainawala HF, 2nd edition (Himalaya Publication, Bombay.)
- Biostatistics- Arora PN, Malhan PK, 1st edition (Himalaya Publishing House, Mumbai.
- How Computers work- White R, 10th edition (Que Publishing).
- How the Internet works-Gralla P, 8th edition (Que Publishing).
- Bioinformatics:A Practical Guide to the Analysis of Genes and Proteins(Methods of Biochemical Analysis-Baxevanis AD, Ouellette BFF, 1st edition(John Wiley & Sons).
- Bioinformatics: Sequence, Structure and Databanks: A Practical Approach- Higgins D, Taylor W, 1st edition(Oxford University Press)

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Department of Higher Education, Madhya Pradesh, Bhopal**

**B.Sc. SECOND YEAR - MICROBIOLOGY
Paper -I Biochemistry and Microbial Physiology**

MM-40

Unit - I

General properties. Classification and function of carbohydrates, lipids, proteins and amino acids, General properties, Classification and nomenclature of enzymes. Factors affecting enzyme activity, mechanism of enzyme action, regulations of enzyme activity, applications of enzymes.

Unit- II

Growth and measurement of growth, mathematical expression of growth curve, growth yield, factors affecting growth effect of nutrients temperature, oxygen, pH, osmotic pressure. Cell count, direct and indirect method, dry weight and weight and wet weight method, synchronous cultures. Continuous culture and batch cultures.

Unit –III

Energy production in anaerobic and aerobic process, glycolysis, Pentose phosphate pathway, Enter Duodoroff pathway, fermentation, glucose fermentation by E. coli, TCA cycle, heterotrophic carbon dioxide fixation, Glyoxylate cycle, catabolism of lipids, a and B-oxidation, catabolism of proteins, aerobic respiration. Principles of bioenergetics, oxidation-reduction reaction, Redox- potential, oxidative phosphorylation hypothesis, inhibitors of oxidative phosphorylation.

Unit-IV

Utilization of Energy, Methods of studying Microbial biosynthesis, assimilation of Ammonia, Nitrogen and Sulphate Utilization of energy in non-biosynthetic and biosynthetic process, Diffusion, gaseous exchange, osmosis, plasmolysis, transport of nutrients in bacteria-active transport, passive diffusion. Facilitated diffusion, group translocation.

Unit-V

Energy production by photosynthesis, photochemical reaction, cyclic and non cyclic photophosphorylation, role of ATP in metabolism, role of reducing power metabolism, role of precursors of metabolism, component of electron transport chain and arrangement of ETC in cell membrane.

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**B.Sc. SECOND YEAR - MICROBIOLOGY
Paper II Microbial Genetics and Molecular Biology**

MM-40

Unit - I

Structure and genetic material of microbes, Nucleic acid as genetic material, physical and chemical structure and different forms of DNA. 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. Gene structure and functions.

Unit – II

Types of DNA Replication, Replication of DNA in prokaryotes and eukaryotes, 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.

Molecular Mechanism of chromosomal replication, Models of chromosomal replication, Cairns model, Rolling Circle models. Transcription in prokaryotes and eukaryotes: steps (initiation, elongation and termination) , enzymes and cofactors involved.

Unit - III

Basic features of genetic code, Biological significance of degeneracy, Wobble hypothesis, polycistronic RNA, overlapping genes, deciphering of genetic code, Gene translocation, Ribosomes, and role in protein synthesis, tRNAs, Translation, initiation , elongation and termination of protein synthesis in prokaryotes, post translational modification of polypeptides, regulation of protein synthesis, Lac operon, Repressible operon.

Unit – IV

Genetics recombination in bacteria, transformation, conjugation, F factor, Hfr strains, transduction in microbes, plasmids and binary vectors, transposons, transformation techniques, use of bacteria and viruses in genetics engineering.

Unit - V

DNA mutation and repair, types of mutation, evidence of spontaneous nature of mutation, fluctuation test, newcomb'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 suppression mutation, DNA repair mechanism, photo reactivation, excision, mismatch, SOS repair and dealkylation repair.

List of practical based on paper I and II for Bsc. II year (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/ Anthrone method.
7. Estimation of protein by Folin Lowry method.
8. Estimation of total lipid By dichromate method.
9. Study of enzyme activity and effect of different factors on enzyme activity.
10. Demonstration on isolation of DNA.
11. Quantitative Estimation of DNA by DPA method.
12. Quantitative Estimation of RNA by Orcinol method.
13. To study Conjugation in Bacteria.
14. To transfer bacterial colonies by replica plating method.
15. Effect of UV light on growth of bacteria.
16. Effect of Mutagen on the growth of bacteria.
17. To study antibiotic resistance in bacteria.
18. Primary screening of amylase/ protease producers.
19. Designing of at least two innovative experiments based on the available facility in the college / University related to Subject .

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B.Sc. THIRD YEAR - MICROBIOLOGY
Paper-I Applied and Environmental Microbiology

Unit I

Design and types of fermentor, factors affecting fermentation process, industrial production of alcohol, organic acid economically important enzymes, amino acids, antibiotics, vitamins. Method of immobilization and applications. Strategy for improvement of industrially important microbial strain.

Unit II

Physical and microbial spoilage of food and food products, spoilage of stored products, fruits and vegetables, spoilage of milk, milk products and meat. Food borne diseases. Food preservation methods, asepsis, pasteurization, canning, desiccation, low temperature, anaerobiosis, filtration, chemical preservation of food salt and sugar, organic acid, sulphur dioxide, ethylene and propylene oxides, wood smoke. Application and production of SCP.

Unit III

Physical and chemical characteristics of soil, soil microflora, soil fertility and management of agricultural soil, rhizosphere and phyllosphere. Microbial disease 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 biofertilizer, mass cultivation of *Rhizobium* and *Azotobacter*, use of blue green algae as biofertilizer.

Unit IV

Concept of environment in relation to microbes, physiological adaptation in microbes, nature of microbial population in soil, water and air. Microbial interaction – neutralism, commensalism, synergism.

Unit V

Bioremediation, Biomagnifications, bioleaching, biopesticides, microbial H₂ production. Impact of genetically modified organisms. Biodegradation of plastics. Liquid waste disposal, characteristics of solid and liquid waste, sewage treatment- primary, secondary and tertiary treatment.

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B.Sc. THIRD YEAR - MICROBIOLOGY
Paper II Immunology and Medical microbiology

Unit I

Structure composition and type of cells and organs involved in immune system. Innate and acquired immunity. Types, structure and functions of MHC molecules, antigen processing and presentation. Humoral and cell mediated immune responses.

Unit II

Antigens – structure, properties and types. Heptens and adjuvants. immunoglobulins- structure, heterogeneity, type and subtype, physico- chemical and biological properties. Theories of antibody production. Generation of antibody diversity. Antigen – Antibody interaction – agglutination, precipitation, immunofluorescence, ELISA, radioimmunoassay. Hybridoma technology – production and applications of monoclonal antibodies.

Unit- III

Tumor Immunology – Cancer, origin, oncogenes, tumor antigen, immune response to tumors, tumor evasion of the immune system, immune diagnosis of tumors.

Unit – IV

Immunization – modern method of vaccine production, autoimmunity, hypersensitivity. Immunohematology, antigen of ABO and Rh blood group system. Medical importance of blood group – ABO and Rh blood group system. Medical importance of blood group- ABO and Rh incompatibility.

Unit- V

Host microbe interaction, mechanism of pathogenicity. Laboratory strategies in diagnosis of infective syndrome. Bacterial and viral disease of human – syphilis, pox, hepatitis. Fungal disease of human- Cryptococcus, candidiasis, Dermatomyces, sexually transmitted disease (STDs).

List of recommended books:

- Introduction of soil microbiology – Alexander M, 2nd edition (John Wiley and Sons New York).
- Soil Microbiology – Subba Rao NS, 4th edition (Oxford and IBH, publishing CO. New Delhi).
- Fundamental Principles of Biotechnology – Salle AJ, 7th edition (Tata McGraw-Hill, New Delhi).
- Microbiology-Pelczar MJ, Chan ECS & Kreig NR, 5th edition (Tata McGraw-Hill, New Delhi).
- A textbook of Microbiology- Dubey R C Maheshwari DK, 2nd edition (S Chand & Co. N. Delhi).

- Food Microbiology - Frazier CW and Westhoff CD, 4th edition (Tata McGrawhill, New Delhi).
- Food microbiology – Adams RM and Moss OM, 3rd edition (RSC publisher).
- Introductory food microbiology - Modi H.A., 1st edition (Aavishkar Publishers, Jaipur).
- Modern food microbiology – Jay J.M., 5th edition (Aspen publisher, Maryland).
- Introduction to Environmental microbiology Michael R, 1st edition (Prentice Hall).
- Bioremediation - Baker KH and Herson DS (Mc Graw Hill, New York).
- Text book of Industrial Microbiology - Patel A.H., 1st edition (Macmillan India Ltd, Madras).
- Industrial microbiology – Cassida LE, 4th edition (Wiley Eastern Ltd, New Delhi).
- Principle of fermentation technology – Stanbary FP, Whitaker A and Hall JS, 2nd edition, (Elsevier, Delhi).
- Fermentation technology – Modi HA, 1st edition (Pointer publisher, Jaipur).
- Biotechnology – industrial microbiology – Crueger W. & Crueger A, 2nd edition (Panima Publisher, Delhi).
- Industrial Microbiology – Prescott SC & Dunn CG, 4th edition (Agrobios India, Jodhpur).
- Industrial microbiology: fundamentals and Application – Agarwal AK & Parihar P, 1st edition (Agrobios India, Jodhpur).
- Kuby Immunology – Kindt TJ, Goldsby RA, Osborne BA, 6th edition (WH Freeman & Co. New York).
- Text book of Microbiology – Ananthnarayan R and Panikar CKJ, 8th edition, (Univ Press Pvt. Ltd. Hyderabad).
- Text book of Microbiology Chakraborty P, 1st edition (New Central Book agency Pvt Ltd).
- Fundamental Immunology – Paul WE, 7th edition (Lippincott Williams & Wilkins, USA).
- Fundamentals of immunology – Coleman RM, Lombord MF and Sicard RE, 2nd edition (WMC Brown, USA).
- Immunology – Weir DM and Steward J, 8th edition (Topley & Wilson, UK).
- Immunology – Rao CV, 2nd edition (Narosa Publishing House, New Delhi).
- Essentials of Immunology – Roitt IM, 11th edition, (Blackwell Pub, USA).
- Immunology – Elgert KD, 2nd edition (Wiley Blackwell).

List of Practical based on paper I and II for B.Sc. III year (MM, 50)

1. Isolation and enumeration of microorganism from air.
2. Isolation and enumeration of microorganism from water.
3. Isolation and enumeration of microorganism 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. Heavy metal sensitivity in microbes.
8. Study of *Rhizobium* bacteria from root nodules.
9. Study of symbiotic and non symbiotic blue green algae.
10. Determination of milk quality by resazurin test or MBRT.

11. Determination of blood group.
12. Estimation of hemoglobin by Sahli's method.
13. Estimation of hemoglobin by cyanmethaemoglobin method.
14. Total count of W.B.C.
15. Total count of R.B.C.
16. Differential W.B.C. count.
17. Flocculation reaction – VDRL
18. Agglutination reaction – Widal test
19. Examination of urine – chemical physical microscopic and bacteriological.
20. Demonstration of ELISA TEST
21. Designing of at least two innovative experiments based on the available facility in the college/ university related to subject.

Important Note:

(Visit to any industry/ Research industry/ research laboratory related to Microbial product during III year)

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BACHELOR OF SCIENCE

MICROBIOLOGY

Scheme of examination for UG course (B.Sc. I, II and III year)

Paper	Maximum marks	Minimum marks for passing
Theory	80	27
Practical	50	17
Internal assessment/CCE (I)	10	04
Internal assessment/CCE (II)	10	04

*Job oriented Project/Internship will be carried out in III Year for 60 hours as per policy of Department of Higher Education.