

MAHAKAUSHAL UNIVERSITY JABALPUR

As per model syllabus of U.G.C. New Delhi, drafted by
Central Board of Studies and Approved by Higher
Education and the Governor of M.P.



विज्ञान संकाय

Faculty of Science

Syllabus & Prescribed Books

Subject – Microbiology

B.Sc. Yearly Examination

I, II & III Year



MAHAKAUSHAL UNIVERSITY JABALPUR

Department of Higher Education, Madhya Pradesh Bhopal
Syllabus approved by Central Board of Studies in Microbiology
SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE

B.Sc. First Year – MICROBIOLOGY

BMCB101-T Paper – I General Microbiology and cell Biology

MM-40

Unit I

Introduction to Microbiology, History, Scope and Development of Microbiology, Branches of Microbiology, Concept of diseases, Contribution 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 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 Structure of Cyanobacteria, Actinomycetes, Mycoplasma, Rickettsia and Chlamydia with emphasis on function of each part components.

Unit III

Classification, Brief introduction to classes 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 cultures, subculturing, overlaying, cultures with mineral oils, lyophilization, sand cultures, storage at low temperature, Major Microbial Culture Collection Centers in India.



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SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE

B.Sc. First Year – MICROBIOLOGY

BMCB102-T 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 application of microscopy, Use of Software in Microscopy.

Unit II

Instruction 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

Occular 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 Suggested books :

- Microbiology –Pelczar MJ, Chan ECS & Kreig NR, 5th edition (Tata McGraw-Hill, New Delhi).
- Fundamentals of Microbiology – Frobisher M, Hinsdill RD, Crabtree KT & Goodheart CR, 9th edition (W.B. Saunders Co.)
- Fundamental Principle of Bacteriology – Salle AJ, 7th edition (Tata McGraw-Hill, New Delhi).
- Microbiology – Prescott LM, Harley JP & Klein DA, 7th edition (Wm. C. Brown Publishers, USA) Elementary Microbiology – Modi, HA (vol. I), 1st edition (Ekta Pakashan, Nadiad).
- A Handbook of Elementary Microbiology – Modi, HA, 1st edition (Shanti Pakashan, Rohtak).
- A Textbook of Microbiology – Dubey RC & Maheshwari DK, 2nd edition (S chand & Co. N. Delhi).
- General Microbiology (Vol I,II,III) – Powar CB & Daginawala 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).

List of Practicals

BMCB101-P

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

1. Demonstration and briefing about principle 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 glass wares.

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. Culture 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 examinations of Fungi – Mucor spp., Aspergillus spp., Penicillium spp. & Altermaria spp. Bacteria – Staphylococcus spp. Lactobaacillus spp. Excherichia spp. Vibrio spp. & Leptospira spp.
13. Staining techniques – Simple staining, Differential staining (Gram's, Ziehl – Neelsen), Spore and Capsular staining methods.
14. Designing of at least two innovative experiments based on the available facility in the college/ University related to subject.



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SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE

B.Sc. Second Year – MICROBIOLOGY

BMCB201-T 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, growth curve, growth yield, factors affecting growth effect of nutrients, temperature, oxygen, pH, osmotic pressure, Cell count, direct and indirect method, dry 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, Entner Doudoroff pathway, fermentation, glucose fermentation by E. Coli, TCA cycle, heterotrophic carbon dioxide fixation, Glyoxylate cycle, catabolism of lipids, α and β –oxidation, catabolism of proteins, aerobic respiration. Principles of Bioenergetics, Oxidation –reduction reaction, Redox-Potential, oxidative phosphorylation hypothesis.

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 in 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

BMCB202-T 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, tRNA, rRNA. Gene Structure and functions.

Unit II

Types of DNA replication, Replication of DNA in prokaryotes and eukaryotes, Conservation, Semi-conservative and Dispersive mode of replication, mechanism of replication, Messelson and Stahl experiment, DNA topology, Super coiling of DNA and linking number, Enzymes involved in replication of DNA.

Molecular Mechanism of chromosomal replication, Models of chromosomal replication, Cairns model, Rolling Circle model. Translation and transcription in prokaryotes and eukaryotes.

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, initiation, elongation and termination of protein synthesis in prokaryotes, post translational modification of polypeptides, regulation of protein synthesis, Lac operon, Repressible operon.

Unit IV

Genetic 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 genetic 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 suppressor mutation, DNA repair mechanism, photo reactivation, excision, mismatch, SOS repair and dealkylation repair.

List of recommended books :

- Microbiology – Pelczar MJ, Chan ECS & Kreig NR, 5th edition (Tata McGraw – Hill, New Delhi).
- 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, New Delhi).
- Microbiology – Prescott LM, Harley JP & Klein DA, 7th edition (Wm. C. Brown Publishers, USA).
- Elementary Microbiology – Modi, HA (vol. I), 1st edition (Ekta Pakashan, Nadiad).
- A Handbook of Elementary Microbiology – Modi, HA, 1st edition (Shanti Pakashan, Rohtak).
- A Textbook of Microbiology – Dubey RC & Maheshwari DK, 2nd edition (S Chand & Co. N. Delhi).
- General Microbiology (Vol I,II,III) – Power CB & Dagainawala HF, 2nd Edition (Himalaya Publication, Bombay) Lehniger – Principles of Biochemistry – Nelson DL & Cox MM, 4th edition (CBS Publishers, New Delhi).
- Microbial Physiology – Moat AG, Foster JW & Spector MP, 4th edition (John Wiley & Sons).
- Fundamentals of Biochemistry – Jain JL, Jain S & Jain N, 8th edition (S Chand & Co. New Delhi).
- Biochemistry – Satyanarayana U, 4th edition (Elsevier, India.)
- Genetics – Russel JP, 2nd edition (Scott, Foresman & Company, USA).
- Principles of Genetics – Gardner JE, Simmons JM & Snustad PD, 8th edition (John Wiley & Sons, Canada).
- Concepts of Genetics – Klug WS & Cummings MR, 10th edition (Benjamin Cummings, USA).
- Microbial Genetics – Freifelder D, 2nd edition (Jones & Bartlett, Boston).
- Molecular Biology & Genetic Engineering – Singh BD, 1st edition (Kalyani Publishers).
- Essentials of Practical Microbiology – Patel B & Phanse N, 1st edition (Print Care, Indore).
- Experiments in Biotechnology – Nighojkar S & Nighojkar A, 1st edition (Satprachar Press, Indore).
- Recombinant DNA Technology – Sardul Singh Sandhu (2008). IK International Publisher, New Delhi.

List of Practicals

BMCB201-P

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. 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/
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B.Sc. Third Year – MICROBIOLOGY

BMCB301-T Paper – I Applied and Environmental Microbiology

MM-40

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 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, Applications 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 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 biofertilizer.

Unit IV

Concept of environment in relation to microbes, physiological adaptation in microbes, nature of microbial population in soil, water and air, Microbial interactions – 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

BMCB302-T Paper – II Immunology and Medical Microbiology

MM-40

Unit I

Structure, composition and types 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. Haptens and adjuvants. Immunoglobulins – structure, heterogeneity, types and subtypes, physico –chemical and biological properties. Theories of antibody production, generation of antibody diversity. Antigen-Antibody interactions – agglutination, precipitation, immunofluorescence, ELISA, Radio immunoassays. Hybridoma technology – Production and applications of monoclonal antibodies.

Unit III

Tumor immunology – Cancer, Origin, oncogenes, tumor antigens, immune response to tumors, tumor evasion of the immune system, immune diagnosis of tumors.

Unit IV

Immunization – Modern methods of vaccine production, autoimmunity, hypersensitivity. Immunohematology, antigens of ABO and Rh blood group system. Medical importance of blood groups – ABO and Rh incompatibility.

Unit V

Host microbe interaction, mechanism of pathogenicity. Laboratory strategies in diagnosis of infective syndrome. Bacterial and viral diseases of human – Syphilis, pox, Hepatitis. Fungal diseases of human – Cryptococcus, Candidiasis, Dermatophytosis, sexually transmitted diseases (STDs).

List of recommended books :

- Introduction to 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 Bacteriology – 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 RC & Maheshwari DK, 2nd edition (S Chand & Co. New Delhi).
- Food Microbiology – Frazier CW and Westoff CD, 4th edition (Tata McGraw hill, New Delhi).
- Food Microbiology – Adams RM and Moss OM, 3rd edition (RSC publisher).
- Introductory food Microbiology – Modi HA, 1st edition, (Aavishkar Publishers, Jaipur).
- Modern Food Microbiology – Jay JM, 5th edition (Aspen Publishers, Maryland).
- Introduction to Environmental Microbiology – Michael R, 1st edition (Prentice Hall).
- Bioremediation – Baker KH and Herson DS (McGraw Hill, New York).
- Textbook of Industrial Microbiology – Patel AH, 1st edition (Macmillan India Ltd. Madras).
- Industrial Microbiology – Cassida LE, 4th edition (Wiley Eastern Ltd, New Delhi).
- Principals 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 Applications – 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.)



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- 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, 2nd edition (Wiley Blackwell).

BMCB301-P

List of Practicals

1. Isolation and enumeration of microorganisms from air.
2. Isolation and enumeration of microorganisms from water.
3. Isolation and enumeration 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. 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 through MBRT.
11. Determination of Blood Groups.
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)