

Department of Microbiology

Semester I syllabus for the years 2013-14 & 2014-15

Paper 1A Introductory Microbiology

Topics to be covered
History of microbiology and Microscopy, Meaning definition and history of Microbiology
Contribution of antony van leeuwenhoek, Edward jenner, Louis pasteur
Robert Koch, Iwanowsky, Beijerinck, winogradsky and Alexander flemming
Applications of microbiology
Bright field, dark field, phase-contrast, fluorescent
Electron microscopy (SEM AND TEM). Ocular and stage micrometers
Principles and types of stains-simple stain, differential stain, negative stain
Structural stains-spore, capsule, flagella, hanging drop method
Sterilization and disinfection techniques
Principles and methods sterilization, physical methods of sterilization
Radiation methods –uv rays, gamma rays, ultrasonic methods
Chemical methods of sterilization –alcohols, aldehydes, fumigants
Halogens, hypochlorites, phenol coefficient
Isolation of pure culture techniques-enrichment culturing dilution plating
Streak plate, spread plate and micromanipulator.
Preservation of microbial cultures, subculturing, overlaying cultures with mineral oils
Lyophilisation, sand cultures
Storage at low temperatures.

Department of Microbiology

Semester I syllabus for the years 2015-16

Paper 1A Introduction to Microbiology, Microbial Techniques and Biology of Microorganisms.

Topics to be covered
History and mile stones in Microbiology-meaning, definition and history of microbiology
Contributions of antony van leeuwenhoek,Edward jenner,Louis pasteur Robert Koch ,Iwanowsky,Beijerinck,winogradsky
Importance & applications of Microbiology
Taxonomy and significance of virology
Protozoa(Entamoeba,leishmania)
Isolation and identification of microorganisms
Principles and types of stains
Simple ,Differential & negative stains
Sterilization and disinfection techniques
Physical methods of sterilization-autoclave,hot air oven,pressure cooker
Radiation methods-U.V RAYS and ultrasonic methods
Chemical methods –use of alcohols, aldehydes,fumigants,phenols
Isolation of pure culture techniques-enrichment culturing, dilution plating
Streak plate,spread plate & micromanipulator
Preservation of microbial culture-subculturing,overlying cultures with mineral oil
Lyophilization, sand cultures
Archae-bacteria, Actinomycetes
Structure and replication ofTMV

Department of Microbiology

Semester I syllabus for the years 2016-17, 2017-18 & 2018-19

Paper 1A Introduction to Microbiology & Microbils Diversity

Topics to be covered
History and mile stones in microbiology. Contributions of Anton von Leeuwenhoek,
Edward Jenner, Louis Pasteur, Robert Koch, Ivanowsky. Importance and applications of microbiology. Classification of microorganisms
Haeckel's three Kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese.
Outline classification of bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology.
General characteristics of Bacteria, Archaea, Mycoplasmas and Cyanobacteria Ultra structure of Prokaryotic cell- Variant components and invariant components. General characteristics of viruses.
Morphology, Structure and replication of TMV and HIV. General characteristics and outline classification of Fungi, Algae and Protozoa.
Principles of microscopy - Bright field and Electron microscopy (SEM and TEM). Staining Techniques –Simple and Differential (Gram Staining and Spore Staining). Sterilization and disinfection techniques - Physical methods – autoclave, hot- air oven, pressure cooker, laminar air flow, filter sterilization,
Radiation methods – UV rays, Gamma rays. Chemical methods – alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites.
Isolation of Microorganisms from natural habitats. Pure culture techiques dilution-plating, Streak-plate, Spread-plate, Pour-Plate and micromanipulator. Enrichment culturing.
Preservation of microbial cultures – subculturing, overlaying cultures with mineral oils lyophilization, sand cultures, storage at low temperature

Department of Microbiology

Semester II syllabus for the years 2013-14, 2014-15 & 2015-16

Paper 1B BIOLOGY OF PROKARYOTIC AND EUKARYOTIC ORGANISMS

Topics to be covered
Outline classification of living organisms, Haeckel, Whittaker, Carl Woese systems
Differentiation of prokaryotes and eukaryotes, general characteristics of bacteria
Archaea, Rickettsias, Mycoplasma, Cyanobacteria and Actinomycetes
Outline classification of bacteria as per the second edition of Bergey's Manual
Ultra structure of bacterial cell, invariants and variants components
General characteristics and classification of viruses, morphology of TMV & HIV
General characteristics and classification of Eukaryotic microorganisms
Outline classification and general characteristics of carbohydrates
General characteristics of proteins
Structure of nitrogenous bases, nucleotides, nucleic acids
Fatty acids (saturated and unsaturated)
Lipids (sphingolipids, sterols and phospholipids)
Hydrogen ion concentration in biological fluids
Types of Buffers and their use in biological reactions
Principle and application of colorimeter
Chromatography (paper and Thin layer)

Department of Microbiology

Semester II syllabus for the years 2016-17, 2017-18 & 2018-19

Paper 1B Microbial Chemistry & Metabolism

Topics to be covered
Outline classification and general characteristics of carbohydrates (monosaccharides, disaccharides and polysaccharides).
General characteristics of amino acids and proteins. Structure of nitrogenous bases, nucleotides, nucleic acids
Fatty acids (saturated and unsaturated) lipids (sphingolipds, sterols and phospholipids).
Principle and applications of - Colorimetry
Chromatography (paper, thin-layer and affinity chromatography)
Spectrophotometry (UV & visible), Centrifugation
Properties and classification of Enzymes. Biocatalysis- induced fit and lock and key models
Role of Coenzymes and Cofactors in enzyme activity. Factors affecting catalytic activity of enzymes.
Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.
Microbial Nutrition –Nutritional requirements and uptake of nutrients by cells. Nutritional groups of microorganisms- autotrophs, heterotrophs, mixotrophs.
Outlines of oxygenic and anoxygenic photosynthesis in bacteria Growth media- synthetic, complex, selective, enrichment and differential media
Microbial Growth- different phases of growth in batch cultures, Synchronous, continuous, biphasic growth.
Factors influencing microbial growth. Methods for measuring microbial growth – Direct microscopy, viable count estimates
Aerobic respiration -Glycolysis, HMP path way, ED path way, TCA cycle, Electron transport
oxidative and substrate level phosphorylation. Anaerobic respiration (Nitrate).
Fermentation - Alcohol and lactic acid fermentations.

Department of Microbiology

Semester III syllabus for the years 2013-14, 2014-15 & 2015-16

Paper 2A Microbial Physiology & Genetics

Topics to be covered
Nutritional requirements and uptake of nutrients by cells
Nutritional groups of Microorganisms
Autotrophs, heterotrophs, Mixotrophs, Methylophs
Different phases of growth in batch culture
Factors influencing microbial growth
Synchronous and continuous growth
Biphasic growth, methods of measuring
Microbial growth-direct microscopy
Viable count estimates, turbidometry, biomass
Enzymes-properties and classification
Enzyme unit, bioanalysis-induced fit, lock and key model
Coenzymes and cofactors
Factors affecting catalytic activity
Inhibition of Enzyme activity-competitive, uncompetitive and allosteric
Glycolysis, HMP Pathway, ED Pathway
Electron transport, Oxidative and substrate level phosphorylation
Anaplerotic reactions, glyoxylate cycle
Fermentation and oxygenic and anoxygenic photosynthesis

Department of Microbiology

Semester III syllabus for the years 2016-17, 2017-18 & 2018-19

Paper 2A Microbial Genetics & Molecular Biology

Topics to be covered
DNA and RNA as genetic material.
Structure and organization of prokaryotic DNA.
Extrachromosomal genetic elements – Plasmids and transposons in bacteria.
Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.
Mutagens - Physical and Chemical mutagens.
Outlines of DNA damage and repair mechanisms
Genetic recombination in bacteria – Conjugation, Transformation and Transduction.
Types of RNA and their functions.
Genetic code.
Structure of ribosomes.
Types of genes – structural, constitutive, regulatory
Protein synthesis – Transcription and translation.
Regulation of gene expression in bacteria
<i>lac</i> operon.
Basic principles of genetic engineering.
Restriction endonucleases, DNA polymerases and ligases.
Vectors like pBR 322, M13.
Outlines of gene cloning methods.
Polymerase chain reaction. Genomic and cDNA libraries.
General account on application of genetic engineering

Department of Microbiology

Semester IV syllabus for the years 2013-14, 2014-15 & 2015-16

Paper 2B Molecular Biology

Topics to be covered
DNA & RNA as genetic materials.structure of DNA
Extra chromosomal genetic elements-plasmids and transposons
Replication of DNA,Proteins involved in DNA Replication
Outlines of Damage and Repair mechanism
Spontaneous and Induced base pair changes
Frame shifts deletions,inversions,tandem duplications
Various physical and chemical mutagens
Gene transfer mechanisms in bacteria-transformation,transduction and conjugation
Concept of gene –muton,recon and cistron
One gene-one enzyme,one gene- one polypeptide
Types of RNA and their functions
Genetic code –structure of , ribosomes and protein synthesis,operon concept
Regulation of gene expression in bacteria,lac operon
Basic principles of genetic engineering-restriction endonucleases
DNA polymerases,ligases,vectors,outlines of gene cloning methods
General account on applications of genetic engineering.

Semester IV syllabus for the years 2016-17, 2017-18 & 2018-19

Paper 2B IMMUNOLOGY & Medical Microbiology

Topics to be covered
Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity.
Primary and secondary organs of immune system – thymus, bursa fabricus, bone marrow, spleen and lymph nodes.
Identification and function of B and T lymphocytes, null cells, monocytes, macrophages,
neutrophils, basophils and eosinophils.
Antigens – types, chemical nature, antigenic determinants, haptens. Factors affecting antigenicity.
Antibodies – basic structure, types, properties and functions of immunoglobulins
Types of antigen-antibody reactions - Agglutinations, Precipitation, Neutralization, complement fixation, blood groups.
Labeled antibody based techniques – ELISA, RIA and Immunofluorescence. Monoclonal antibodies – production and applications.
Concept of hypersensitivity and Autoimmunity.
Normal flora of human body. Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection,
General principles of diagnostic microbiology- collection, transport and processing of clinical samples.
General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods
Antibacterial Agents- Penicillin, Streptomycin and Tetracycline. Antifungal agents – Amphotericin B, Griseofulvin
Antiviral substances - Amantadine and Acyclovir Tests for antimicrobial susceptibility.
Brief account on antibiotic resistance in bacteria - Methicillin-resistant Staphylococcus aureus (MRSA). Vaccines – Natural and recombinant
Bacterial diseases – Tuberculosis and Typhoid Fungal diseases – Candidiasis. Protozoal diseases – Malaria.

Semester V syllabus for the years 2013-14, 2014-15, 2015-16 & 2016-17

Paper 3A IMMUNOLOGY

Topics to be covered
Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity
Primary and secondary organs of immune system – thymus, bursa fabricus, bone marrow, spleen and lymph nodes.
Identification and function of B and T lymphocytes
null cells, monocytes, macrophages,
neutrophils, basophils and eosinophils.
Antigens – types, chemical nature, antigenic determinants, haptens. Factors affecting antigenicity.
Antibodies – basic structure, types,
properties and functions of immunoglobulins
Types of antigen-antibody reactions - Agglutinations, Precipitation, Neutralization, complement fixation, blood groups.
Labeled antibody based techniques
ELISA, RIA
Immunofluorescence.
Polyclonal & monoclonal antibodies
Monoclonal antibodies – production and applications.
Types of hypersensitivity-immmediate & delayed
Autoimmunity & its significance

PAPER 4A Environmental Microbiology

Topics to be covered
Physical & chemical characteristics of soil
Rhizosphere and phyllosphere
Plant growth promoting microorganisms
Outlines of biological nitrogen fixation(symbiotic& non symbiotic)
Biofertilizers&concept of diseases in plants
Symptoms of plant diseases caused by fungi,bacteria
Principles of plant disease control
Biological control of plant diseases
Biopesticides-bt,NPV
Microorganisms of environment
Role of microorganisms in nutrient cycling
Microbial interactions-Mutualism,commensalism,antagonism
Microbiology of potable and polluted water
Sanitation of potable water
Sewage treatment(primary,secondary,tertiary)
Outlines of biodegradation of environmental pollutants
Solid waste disposal ,sanitary land fills,composting
Microbiology of air and air sampling methods

Semester V syllabus for the years 2017-18 & 2018-19

Paper 3A ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

Topics to be covered
Terrestrial Environment: Soil profile and soil microflora
Aquatic Environment: Microflora of fresh water and marine habitats
Atmosphere: Aeromicroflora and dispersal of microbes
Role of microorganisms in nutrient cycling (Carbon, nitrogen, phosphorus)
Treatment and safety of drinking (potable) water, methods to detect potability of water samples:
standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms
Membrane filter technique. Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.
Outlines of Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal
composting and sanitary landfill
Liquid waste management: Composition and strength of sewage (BOD and COD)
Primary, secondary (oxidation ponds, trickling filter, activated sludge process
septic tank and tertiary sewage treatment.
Plant Growth Promoting Microorganisms - Mycorrhizae, Rhizobia, <i>Frankia</i> , phosphate-solubilizers and Cyanobacteria
Outlines of biological nitrogen fixation (symbiotic, non-symbiotic). Biofertilizers - <i>Rhizobium</i> .
Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses.

Paper 4A FOOD & INDUSTRIAL MICROBIOLOGY

Topics to be covered
Intrinsic and extrinsic parameters that affect microbial growth in food
Microbial spoilage of food - fruits, vegetables, milk, meat, egg, bread and canned foods
Food intoxication (botulism). Food-borne diseases (salmonellosis) and their detection.
Principles of food preservation - Physical and chemical methods.
Fermented Dairy foods – cheese and yogurt.
Microorganisms as food – SCP, edible mushrooms white button, oyster and paddy straw
Probiotics and their benefits
Microorganisms of industrial importance – yeasts,(<i>Saccharomyces cerevisiae</i>) moulds <i>Aspergillus niger</i> , <i>Bacteria</i> (<i>E.coli</i>), actinomycetes (<i>Streptomyces griseus</i>).
Outlines of Isolation and Screening and strain improvement of industrially-important microorganisms.
Types of fermentation processes – solid state, liquid state, batch, fed-batch, continuous
Basic concepts of Design of fermenter. Ingredients of Fermentation media
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.
Microbial production of Industrial products - Citric acid Ethanol, amylases, penicillin, glutamic acid and vitamin B12.

Semester VI syllabus for the years 2013-14, 2014-15, 2015-16 & 2016-17

Paper 3B MEDICAL MICROBIOLOGY

Topics to be covered
History of Medical microbiology
Normal flora of human body
Definition of infection, non-specific defence mechanism
Mechanical barriers, antagonism of indigenous flora
Antibacterial substances-lysozyme, complement
Properdin, antiviral substances, phagocytosis
General principles of diagnostic microbiology
collection, transport and processing of clinical samples.
General methods of laboratory diagnosis - cultural, biochemical serological and molecular methods
Tests for antimicrobial susceptibility
Antiviral agents-interferons Host pathogen interactions. bacterial toxins
Elements of chemotherapy, mode of action of penicillin
Prevention and control of diseases & vaccines
Airborne diseases-Tuberculosis, food borne diseases-cholera, typhoid
Insect borne diseases-Malaria, dengue fever
Contact and zoonotic diseases, blood borne diseases

Paper 4B Food & Industrial Microbiology

Topics to be covered
Microbiology of food spoilage and their sources
Microbial spoilage of food - fruits, vegetables, milk, meat, egg, bread and canned foods
Food intoxication (botulism). Food-borne diseases (salmonellosis) and their detection.
Principles of food preservation - Physical and chemical methods.
Fermented Dairy foods – cheese and yogurt.
Microorganisms as food – SCP, edible mushrooms white button, oyster and paddy straw
Probiotics and their benefits
Microorganisms of industrial importance – yeasts,(<i>Saccharomyces cerevisiae</i>) moulds <i>Aspergillus niger</i> , <i>Bacteria</i> (<i>E.coli</i>), actinomycetes (<i>Streptomyces griseus</i>).
Outlines of Isolation and Screening and strain improvement of industrially-important microorganisms.
Types of fermentation processes – solid state, liquid state, batch, fed-batch, continuous
Basic concepts of Design of fermenter. Ingredients of Fermentation media
Microbial production of Industrial products - Citric acid Ethanol, amylases, penicillin, glutamic acid and vitamin B12.

Semester VI syllabus for the years 2017-18 & 2018-19

Paper 3B Ecology

Topics to be covered
Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.
Genetically engineered microbes for industrial application: Bacteria and yeast
Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine).
Over view of production and applications of Microbial polysaccharides
Bioplastics and Microbial biosensors
Microbial based transformation of steroids and sterols.
Bio-catalytic processes and their industrial applications: Production of high fructose syrup
production of cocoa butter substitute.
Immobilization methods and their application: Whole cell immobilization
Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass.
Biogas production: Methane and hydrogen production using microbial culture.
Microorganisms in bioremediation
Degradation of xenobiotics.
Mineral recovery, removal of heavy metals from aqueous effluents
Outlines of Intellectual Property Rights
Patents, Copyrights, Trademarks

PAPER 4B MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

UNIT – I

Good laboratory practices - Good microbiological practices.

Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3.

Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

UNIT – II

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products

UNIT – III

Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – IV

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, *Salmonella Shigella* Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar

Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

UNIT – V

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations
Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

PAPER 5B BIOFERTILIZERS AND BIOPESTICIDES

UNIT – I

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N₂ fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

Frankia from non-legumes and characterization.

Cyanobacteria and *Azolla*, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT – II

Free living *Azospirillum*, *Azotobacter* - isolation, characteristics, mass inoculum production and field application.

UNIT – III

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

UNIT – IV

Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT – V

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides.

Bacillus thuringiensis - production, Field applications.

Viruses – NPV cultivation and field applications.

PAPER 6B PROJECT WORK

