# MSc MICROBIOLOGY

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**DEPARTMENT OF MICROBIOLOGY, OSMANIA UNIVERSITY**

Schedule for Instruction and Examination

(Proposed Scheme for Academic year 2016 onwards)

## SEMESTER – I

<table>
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<tr>
<th>Syllabus Ref No</th>
<th>Subject</th>
<th>Credits</th>
<th>Teaching Hours</th>
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### SEMESTER – IV

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### PRACTICALS

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| Total           | 24       | 32              | 60     | 520    | 600   |
| GRAND TOTAL     | 96       | 128             | 300    | 2100   | 2400  |
M.Sc. (Previous) I Semester (CBCS)
Paper I MB General Microbiology (Core) (CBCS)
(4 HPW-4 Credits)

Unit I
Pioneers of Microbiology.
Microscopy - Principles, working and applications of bright field microscope, fluorescent microscope, Phase contrast microscope, electron microscope.
Microbial Cell Structure: Prokaryotic cell, Eukaryotic cell, Organization and function of cellular organelles. Bacterial endospore structure, biochemistry and genetics of sporulation

Unit II
Methods of sterilization and disinfection: Physical methods and chemical methods.
Microbiological media - Autotrophic media, defined synthetic mineral media, heterotrophic media. The concept of prototrophs and auxotrophs, prototrophic (minimal media) complex media (undefined media).
Cultivation of Bacteria, Fungi and Algae : Routine and special culture methods.
Isolation of pure cultures.
Preservation and Maintenance of Microbial Cultures: Routine methods and Liquid nitrogen preservation, freeze-drying (lyophilization), etc.

Unit III
Identification methods and classification of bacteria: -
Microscopic identification characteristics, staining methods. Ecological identification methods, Nutritional (cultural) identification characters, biochemical identification methods, immunological characteristics, Molecular and genetic characteristics identification (16s rRNA).
Microbial nutrition and metabolism: autotrophy – Photoautotrophy and bacterial photosynthesis Chemoautotrophy and heterotrophic metabolism.

Unit IV
Microbial growth: The concept of growth and definition, formation of protoplasm, building of macromolecules from elemental nutrients, supramolecules, orgnelles of cell and cellular components. Cell cycle in microbes and generation time.
Growth phases of bacteria – Lag phase, exponential (logarithmic) phase, stationary (ideo) phase, decline and survival of microbial cells. Importance of each growth phase.
Synchronous cultures – Methods of synchronous culturing, Continuous culturing methods, factors effecting growth.
Methods of growth measurement.
Recommended books

Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
Text book of Microbiology by M. Burrows
General Microbiology by Stainier, Deudroff and Adelberg
Review of medical microbiology by Jawitz, melnick and Adelberg
Bacterial and Mycotic infections of man. Ed. Dubos and Hirst Lipincott
Principles of Microbiology and Immunology by Davis, Dulbecco, Eison, Ginsberg and Wood.
Structure and Reproduction of Algae, Vol. I & II by Fritsch, F.E.
Introduction to Algae by Morris, I.
Products and Properties of Algae by Zizac.
Fresh water algae of the United States by Smith, GM.
Introductory Mycology by Alexopolus, C.J.
Dispersal in Fungi by Ingold, CT
Microbial Physiology by Moat,
Laboratory Experiments in Microbiology by Gopal Reddy et al
Microbes in Action by Seoley HW and Van-Demark, PJ
Brock’s Biology of microorganisms by Madigan, MT et al
M.Sc. (Previous) I Semester Microbiology (CBCS)
  Paper II  MB Virology (Core) (CBCS)
  (4 HPW-4 Credits)

**Unit I**
History of virology (latest Scientific investigations), Viral classification and nomenclature
(Baltimore and ICTV system of classification). Virus structure and morphology. Detection of
viruses: physical, biological, immunological, serological and molecular methods.
Propagation, purification, isolation, characterization, identification and quantification of
bacteriophages, plant viruses and animal viruses.
Sub-viral particles: Discovery, structure, replication and diseases caused by satellites virus,
viroids and prions. General idea about cyanophages, actinophages and mycophages.
Evolutionary importance of virus. Metagenomics for virus characterization: RNA-DNA hybrid
virus

**Unit II**
Virus replication Strategies: Principal events involved in replication: Adsorption, penetration,
uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and
release, viral-host interaction, Host response to viral infection. Cellular interactions—clathrin
coated pits, lipid rafts, endocytosis and virus uncoating mechanisms. Comparison of Lytic cycle
and lysogeny cycle (T2 Bacteriophage, Lambda).
Morphology, Ultrastructure, Genome organization and Replication strategies of Group I
Adenovirus; Group II – Banana bunchy top virus, Group III – Reovirus, Group IV- TMV, Group
V – Influenza virus, Group VI – HIV, Group VII – HBV.

**Unit –III**
Recombination in phages, multiplicity reactivation and phenotypic mixing
General account of Tumor virus (RNA and DNA).
Induction of interferons. Antiviral agents (chemical and biological) and their mode of actions

**Unit –IV**
Introduction to viral vaccines, preparation of vaccines. Viruses as cloning vectors. Vectors used
Baculovirus System for insect cell lines and its importance
Silver lining: viruses as therapeutic agents, viruses for gene delivery, viruses to destroy other
viruses. Importance of studying modern virology.
I Semester Practicals Paper I
(CBCS) General Microbiology and Virology (4 HPW-3Credits)

1. General instructions, Microbiology laboratory and its discipline
2. Handling of microscopes, Calibration and measurement of microscopic objects
3. Staining techniques for bacteria – simple, differential and special stainings
4. Sterilization procedures/methods
5. Preparation of microbiological media. Autotrophic media, minimal media, basic media, enriched media, enrichment media, differential media.
6. Isolation and cultivation of pure cultures
7. Identification methods of bacteria
8. Isolation and culturing of fungi (yeasts and molds) and algae
9. Culturing methods of microbes – slant and stab cultures, tube culture, flask cultures, shake flask cultures
10. Anaerobic culturing methods – anaerobic jar and its use, pyrogallol method, thioglycollate media culturing, anaerobic glove box and its application
11. Microbial growth experiments – Viable count of growing cultures and generation time determination
12. Study of bacterial growth curve
13. Factures effecting the microbial growth (pH and temperature)
14. Isolation of phage from different soil samples using laboratory bacterial cultures (Staphylococcus, Bacillus)
15. Isolation of phage from sewage using Pseudomonas and E. coli as host.
17. Quantification of phages
18. Growth phages of phage and burst size (Demonstration)
19. Phage induction
20. Cultivation of animal viruses in egg allantoic, amniotic and CAM
21. Symptomatic observations / slides plant viral infections
22. Demonstration of cytopathological changes of animal virus (slides/pictures)
**Recommended Books**
Recent publications: Research papers and review articles
General Virology by Luria and Darnel
Virology and Immunology by Jokli
Text book of Virology by Rhodes and Van Royen
Plant Virology by Smith
Genetics of bacteria and their viruses by W. Hayes
Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner
A laboratory guide in virology by Chjarles H. Lunningham
Basic lab procedures in diagnostic virology by Marty Cristensen
Review of medical microbiology by Jawitz et al
Medical laboratory manual for tropical countries Vol I & II by Monica Cheesbrough
Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker
Viral and Ricketsial infections of Man by Horsfall and Jam
Text book of Virology by Rhodes and Van Royan
Virological Procedures by Mitchal hasking
Virologoy by Wilson and Topley
M.Sc. (Previous) Microbiology I Semester (CBCS)
Paper III MB Research Methodology & Techniques (Core) (CBCS)
(4 HPW-4 Credits)

Unit I
Optical methods; colourimetry and spectrophotometry, fluorimetry, optical rotation
Circular dichroism, NMR, ESR spectroscopy, x-ray diffraction, types of mass spectrometry.
Electrophoretic techniques and application, counter current distribution.

Unit II
Separation methods: Chromatographic techniques – HPLC, FPLC paper, thin layer, ion exchange,
gel filtration and affinity chromatography.
Diffusion, dialysis, cell disruption methods, centrifugation techniques, cell free extracts and their
use in metabolic studies.
Radio isotopes – detection and measurement of radioactivity – scintillation counters,
autoradiography, stable isotopes and their use. Safety precautions. General method of study of
intermediary metabolism in microbes. Uses of mutants in study of metabolism.

Unit III
Population, samples and sampling procedures, variables, variations and frequency distributions,
measures of central tendency and dispersion, element of probability, gaussian or normal
distribution, binomial distribution, poisson distribution, ‘t’ distribution, ‘F’ distribution and Chi-
square distribution, correlation and linear regression.
Normal curve test, ‘t’ test, ‘F’ test, ANOVA, analysis of covariance, Chi-square test, and
confidence intervals. DMRT and its use in biological experiments. Experimental designs using
statistical tools.

Unit IV
Introduction to Computers
Introduction to disk operating systems (DOS): Sample commands, DIR-CD-RD-DEL-COPY-
MOVE-REN-TYPE-EDIT (Editor) CE-DATE and TIME.
Introduction to Windows: Word Processing: Electronic Spread Sheet
Data collection, Data representation, Manuscript preparation, Plagiarism, Research ethics, QA,
QC, GLP, GMP, Patents & IPR
I Semester Practicals Paper II
(CBCS Research Methodology and Techniques)
(4 HPW-2Credits)

1. Creating documents using word processor
2. Usage of spread sheet to biological applications
3. Biochemistry calculations and statistics
4. Absorption maxima of proteins, NA, tyrosine and riboflavin (Determination of molar extinction coefficient, calculations based on Beer Lambert’s Law)
5. Estimation of inorganic and organic phosphate by Fiske-Subbarow method
6. Estimation of protein concentration by UV-vis spectrophotometry and Folin Lowry method
7. Differential centrifugation
8. Paper chromatography of amino acids
9. Dialysis for desalting of proteins
10. Demonstration of Gel filtration technique
11. Demonstration of electrophoresis of proteins and DNA

Recommended books
Biochemistry by Lehninger
Outlines of Biochemistry by Cohn and Stumph
Biological Chemistry by Mullar and Cards
Biochemistry by White, Handler and Smith
Methods in Enzymology series
The Cell – Bratch amd Mirsky series
Laboratory experiments in Microbiology by Gopal Reddy et al
Biochemistry lab manual by Jayaraman
Introduction to the theory of statistics by Alexander, M Mood and Franklin
Fundamentals of Biometry by L.N.Balam
Statistical methods by Snedecor and Cochran
Introduction to computer and its application by Chae C.Chien
Basic Programming language by Bajaraman
Unit I
pH and its biological relevance
Determination of pH, preparation of buffers
Concept of entropy, free-energy, free energy changes, high energy compounds. Equilibrium
constants, Redox potentials, Biological redox systems, Biological oxidation, biological
membranes, electron transport, oxidative phosphorylation and mechanism.
Respiration (Aerobic and anaerobic) and fermentation. Glycolysis (EMP, HMP and ED)
pathways. TCA Cycle and its integration.

Unit II
Lipids classification: Bacterial lipids, prostaglandins, structure, function, Major steroids of
biological importance.
Carbohydrates: Classification, basic chemical structure, monosaccharides, aldoses, and
ketoses, cyclic structure of monosaccharides, stereoisomerism, anomers and epimers.
Sugar derivatives, deoxy sugars, amino sugars, and sugar acids.
Nucleic acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides.
Metabolism of purines and pyrimidines - Biosynthesis and degradation

Unit III
Proteins and amino acids: Properties of amino acids, structure, confirmation and properties of
proteins, metabolism of amino acids, biosynthesis and degradation – an overview.
Enzymes nomenclature, classification methods for determination of enzyme activity. Isolation
and purification of enzymes. Enzyme kinetics: Effect of pH, substrate concentration, temperature
and inhibitors.

Unit IV
Control of enzymes. Mechanism of enzyme action – Action of Hydrolases, Oxidases and
reductases. Coenzyme catalysis(pyridoxal phosphate and TPP). Isoenzymes. Competitive and
non-competitive inhibition. Methods for increased microbial enzymes production and activity.
Enzyme engineering. Control of enzymes. Regulation of enzyme activity: allosteric enzymes and
feed back mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and
secondary metabolites
I Semester Practicals Paper III
(CBCS Microbial Biochemistry)
(4 HPW-2Credits)

1. Safety and good lab practices
2. Preparation of buffers and adjustment of pH
3. Qualitative tests for carbohydrates and analysis of unknowns
4. Qualitative tests for amino acids and analysis of unknowns
5. Tests for lipids (qualitative)
6. Quantitative estimation of glucose and fructose
7. Determination of saponification value of fats
8. Partial purification of enzymes (β-amylase, urease and catalase)
9. Effect of substrate concentration, pH, time and temperature on enzyme activity
10. Calculation of Km for partially purified enzyme
11. Study for inhibition of enzyme activity

Recommended Books

Biochemistry by Lehninger
Outlines of Biochemistry by Cohn and Stumph
Biochemistry of Nucleic acids by Davidson
Biological Chemistry by Mullar and Cards
Biochemistry by White, Handler and Smith
Methods in Enzymology  series
The Cell – Bratch and Mirsky  series
Biochemistry lab manual  by Jayaraman
M.Sc. (Previous) Microbiology II Semester (CBCS)
Paper I MB Molecular Biology & Microbial Genetics (Core) (CBCS)
(4 HPW-4redits)

Unit I
Detailed structure of DNA, Z-DNA, A & B DNA, Denaturation and melting curves.
Genome organization in prokaryotes and eukaryotes, Enzymes involved in DNA replication,
Modes of DNA replication- Detailed mechanism of Semiconservative replication.
Plasmids: nature, classification, properties and replication.
Eukaryotic telomere and its replication.

Unit II
Prokaryotic and eukaryotic transcription. Structure and processing of m-RNA, r-RNA t-RNA.
Ribozyme, Genetic code and Wobble hypothesis, Translation in Prokaryotes and eukaryotes,
Post translational modifications, Gene regulation and expression – Lac operon, arabinose and
tryptophane operons, Gene regulation in eukaryotic systems, repetitive DNA, gene rearrangement,
promoters, enhancer elements.

Unit III
Types of mutagens, Molecular basis of mutations. Physical and chemical mutagenic agents: UV,
Ethidium Bromide and Nitrous oxide. Detection and analysis of mutations (Replica plating,
Antibiotic enrichment, Ames test etc). DNA damage and repair mechanisms. Global response to
DNA damage. Transposable elements – Types of bacterial transposons and their applications.

Unit IV
Bacterial Recombinations-Discovery, gene transfer, molecular mechanism, detection, efficiency
calculation and applications. Bacterial transformation- Competency and resistance.
Bacterial conjugation – Sex factor in bacteria, F and HFR transfer, linkage mapping.
Bacterial transduction – transduction phenomenon, methods of transduction, co-transduction,
generalized, specialized and abortive transduction, sex-ductions.
II Semester Practicals Paper I  
Molecular Biology and Microbial Genetics (CBCS)  
(4 HPW-2Credits)

1. Isolation of genomic DNA from E.coli and Yeast.  
2. Estimation of DNA and RNA (colorimetry)  
3. Determination of molecular weight of DNA, resolved on agarose gel electrophoresis  
4. Induction of Lac operon  
5. Induction of mutations by physical/chemical mutagens, screening and isolation of mutants,  
   Replica plating technique  
6. Transformation in bacteria  
7. Conjugation in bacteria  
8. Protoplast preparation, Fusion and regeneration

**Recommended books**  
Molecular biology by Robert Weaver  
Molecular Biology By Upadhyay and Upadhyay  
Molecular biology by David and Freifelder  
Microbial genetics by David and Freifelder  
molecular biology malacinski  
Molecular biology of thee gene by Watson et al  
The Lehninger Biochemistry  
Molecular biotechnology by Primrose  
Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak  
Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness
M.Sc. (Final) Microbiology II Semester (CBCS)
MB Paper II Environmental and Agricultural Microbiology (Core) (CBCS)
(4 HPW-4Credits)

Unit I
Microorganisms in air and their importance (brief account); Microorganisms and water pollution
Water-borne pathogenic microorganisms and their transmission; Sanitary quality of water; Water
pollution due to degradation of organic matter; Aerobic sewage treatment – Oxidation ponds, trickling
filters, activated sludge treatment; Anaerobic sewage treatment – Septic tank.

Unit II
Strategies for bioremediation technologies. Bioaugmentation; Methods of enumeration and activity of
microbes in environment; Microbial biodegradation of organic pollutants; A brief account of
biodegradable plastics and super bug. Microorganisms and their roles in fundamental
biogeochemical cycles.

Unit III
Degradation of carbonaceous materials in soil – cellulose, hemicellulose and lignin
decomposition, factors governing the decomposition and biochemistry of decomposition, Soil
humus formation, Nitrification –Microbes involved, factors influencing nitrification,
nitrifying bacteria and biochemical mechanism. Denitrification – microbes involved, factors
influencing and the mechanism of denitrification. Nitrate and phosphate pollution

Unit IV
Nitrogen fixation – Asymbiotic and symbiotic nitrogen fixation, microorganisms involved,
biochemistry and genetics of nitrogen fixation, measurement of nitrogen fixation, ecological
and economic importance of nitrogen fixation. Biofertilizers – bacterial fertilizers and
production of rhizobial inoculants and blue-green algae, quality control tests, Microbes and
plant interactions – Rhizosphere, Phyllosphere and Mycorrhizae.
II Semester Practical II
Environmental and Agricultural Microbiology -CBCS
(4 HPW-2Credits)

1. Isolation and observation of air microflora
2. Enumeration of soil microorganisms (bacteria, actinomycetes, fungi) by standard plate count
3. Estimation of soil microbial activity by CO₂ evolution
4. Estimation of BOD
5. Testing for microbial sanitary quality of water (coliform test )
6. Bioremediation plastics
7. Bioremediation of organic pollutants and their effect on soil microbial activity
8. Isolation of cellulose decomposing microbes and estimation of cellulose activity
9. Estimation of ammonifiers, nitrifiers and denitrifiers in soil by MPN METHOD
10. Isolation and culturing of Rhizobium sp from root nodules and Azospirillum from grasses (Cyanodon)
11. Biological enrichment isolation of Rhizobium from soil by Leonard Jar experiment
12. Nodulation testing by tube/jar method
13. Observation and assessment of soil algae/algal biofertilizers
14. Estimation of N₂ fixation (Micro Kjeldahl method/GC method)
15. Isolation and observation for phyllosphere microflora
16. Isolation and observation for rhizosphere microflora
17. Observation for Mycorrhizae

Recommended Books

Recent Published papers on advances in relevant area to be referred
Soil Microbiology by Alexander Martin
Microbial ecology, Fundamentals and Applications Ed. Benjamin-Cummings
Environmental Biotechnology-Fundamentals and applications. By Parihar (Agrobios india – publishers)
Soil Microbiology by Singh, Purohit, Parihar published by student edition.
Soil Biotechnology by J M Lynch
Microbial Ecology: Organisms, Habitats, and Activities by Stolp, H.
Soil Microbiology and Biochemistry by Paul E. and PE Clank
Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul
Biological Nitrogen Fixation by Quispel
Soil Microorganisms and Plant Growth by N.S., Subba Rao.
Laboratory experiments in microbiology by Gopal Reddy et al
Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology by K R Aneja
Biofertilizers for sustainable Agriculture by Arun K. Sharma
Environmental Microbiology by K. Vijaya Ramesh (MJP Publishers)
Brock Biology of Micro organisms by Madigan et al
Waste water microbiology by Bitton, G.
Waste water treatment – Biological and chemical process by Henze, M.
Bioremediation - Principles and Applications by Ronald L Crawford and Don L Crawford, Cambridge University Press
Unit I
History of immunology. Hematopoiesis, Cell lineage, components of immune system, cells and organs of immune system.
Antigens –Nature, properties and types. Haptens
Antibody -Structure, functions and classification. Isotypes, allotypes and idiotypes.
Generation of T cell receptor diversity by genomic rearrangement
Structure of B and T cell receptors

Unit II
Overview of Innate and adaptive immunity
Toll-like receptors, cell-mediated and humoral immune responses, inflammation.
Major Histocompatibility Complex (MHC). Human leucocyte antigen (HLA) restriction
Processing and presentation of antigen by MHC. Transplantation immunity,
Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections,
Congenital and acquired immunodeficiencies.
Immunological tolerance-central and peripheral.

Unit III
Auto immunity and Hypersensitivity - immediate and delayed type hypersensitivity reactions.
Classical and alternate Complement pathways
Antigen and antibody reactions–Agglutination, Precipitation, neutralization, and function. Labeled antigen-antibody reactions- ELISA, RIA, immune blotting, CFT, immunofluorescence. Flow cytometry (Fluorescence activated cell sorter) and its applications in Immunology. Development of immuno diagnostic kits.

UNIT -IV
Types of conventional vaccines and principles of Immunization.
Modern vaccines; peptide, DNA, recombinant / vector, and anti-idiotypic vaccines
Schedules of common vaccination, Benefits and adverse consequences of vaccination.
Production of polyclonal antibodies; Animals models for production of antibodies
Hybridoma techniques and monoclonal antibody production. Applications of monoclonals in biomedical research, clinical diagnosis and treatment. Chimeric Antibodies.
Immunosuppression and its mechanism of action.
Immune evasion by bacteria and viruses.
Tumor immunology. Immuno diagnosis and immune therapy of cancer
Recommended Books
Kuby Immunology
Cellular and molecular immunology by Abul K. Abbas et al
Test book of Immunology by Barret
Immunology – The science of self-non self discrimination by Jan Klein
Essential Immunology by Roitt, IM
Immunology by Tizard
The elements of Immunology by Fahim Halim Khan
Immunology and immunopathology by Stewart Sell
M.Sc. (Previous) Microbiology II Semester (CBCS)
Paper IV MB Pharmaceutical Microbiology (Core) (CBCS)
(4 HPW=4Credits)

Unit I
Microorganisms affecting pharmaceutical industry – The atmosphere, water, skin & respiratory flora of personnel, raw-materials, packing, equipments, building, utensils etc. Types of microorganisms occurring in pharmaceutical products.
Microbiological spoilage prevention of pharmaceutical products.
Preservation of pharmaceutical products; antimicrobial agents used as preservatives, evaluation of the microbial stability of formulation
The sterilization in pharmaceutical industry
Good manufacturing practices in pharmaceutical industry

Unit II
History of chemotherapy – plants and arsenicals as therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes. Development of synthetic drugs – Sulphanamides, antitubercular compounds, nitrofurans, nalidixic acid, metronidazole group of drugs.
Antibiotics - The origin, development and definition of antibiotics as drugs, types of antibiotics and their classification. Non-medical uses of antibiotics.
Cosmetics microbiology- testing methods and preservation
Antimicrobial preservation efficacy and microbial content testing

Unit III
Principles of chemotherapy – Clinical and lab diagnosis, sensitivity testing, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage.
Mode of action of important drugs – Cell wall inhibitors (Betalactam – eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), antifungal antibiotics (nystatin)

Unit IV
The drug resistance – The phenomenon, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria.
Microbiological assays: Assays for growth promoting substances, nutritional mutants and their importance, vitamin assay, amino acid assay
Introduction to pharmacokinetics and pharmacogenomics.
II Semester Practicals Paper III
Immunology and Pharmaceutical Microbiology (CBCS)
(4 HPW-3 Credits)

1. Agglutination reactions – Widal, VDRL, HA, Blood typing – tube method
   Precipitation test: Ring interphase, single radial diffusion.
2. Ouchterlony double diffusion.
3. Immunelectrophoresis.
5. WBC and RBC count and differential blood picture.
7. Blot transfer and detection of protein on blot by staining.
8. ELISA
9. Purification of IgG from serum
10. Lymphocyte culture, viable staining and heamocytometer count.
11. Indirect agglutination (Pregnancy hCG Ag)
12. Sterility testing methods for pharmaceutical and cosmetic products
13. Tests for disinfectants (Phenol coefficient/RWC)
14. Determination of antibacterial spectrum of drugs/antibiotics
15. Chemical assays for antimicrobial drugs
16. Testing for antibiotic/drug sensitivity/resistance
17. Determination of MIC valued for antimicrobial chemicals
18. Microbiological assays for antibiotics (Liquid tube assay, agar tube assay, agar plate assays)
19. Efficacy testing of preservatives like parabens

Reference/Recommended Books for MB Pharmaceutical Microbiology

Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore
Pharmaceutical Microbiology. Huge, W.B. and Russel, AD.Blackwell Scientific, Oxford
Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press, NY
Microbiological Assays. Hewitt.
Antiviral Drugs. Kargor, S.
The control of antibiotic resistant bacteria. Stuart, Harris and Harris.
Indian Pharmacopea; United States Pharmacopea; British Pharmacopea.