

**M.Sc. (Previous) I Semester (CBCS)**  
**Paper I MB 101 General Microbiology (Theory) (CBCS)**  
**(7 Hrs per week = 5 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.

Methods of sterilization: Physical methods and chemical methods.

Microbial identification: staining methods and microscopic. Ecological, Nutritional (cultural) biochemical methods, immunological characteristics, Molecular and genetic characteristics (16s rRNA and ITS).

**Unit II**

Principles of bacterial taxonomy and classification: - Numerical taxonomy, Bergey's manual and its importance, general properties of bacterial groups.

Microbial growth: The concept of growth and definition, formation of protoplasm, building of macromolecules from elemental nutrients, supramolecules, organelles of cell and cellular components. Cell cycle in microbes and generation time.

Growth phases of bacteria and importance of each growth phase.

Synchronous cultures – methods of synchronous culturing, Continuous culturing methods, factors effecting growth. Methods of growth measurement.

**Unit III**

Microbiological media - Autotrophic media, defined synthetic mineral media, heterotrophic media. The concept of prototrophs and auxotrophs, prototrophic (minimal) media (defined 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.

Microbial nutrition and metabolism: autotrophy – Photoautotrophy and bacterial photosynthesis  
Chemoautotrophy and heterotrophic metabolism.



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**DEPARTMENT OF MICROBIOLOGY, OSMANIA UNIVERSITY**  
**MSc MICROBIOLOGY**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
Schedule for Instruction and Examination  
(Proposed Scheme for Academic year 2022 onwards)

<b>SEMESTER – I</b>						
Syllabus Ref No	Subject	Credits	Teaching Hours	Marks		
				Internal Assessment	Semester Exam	Total
<b>THEORY</b>						
MB 101	General Microbiology & Microbial Physiology (Core)	3	3 <sub>1</sub>	30	70	100
MB 102	Virology (Core)	3	3 <sub>1</sub>	30	70	100
MB 103	Research Methodology & Techniques (Core)	3	3 <sub>1</sub>	30	70	100
MB 104	Microbial Biochemistry (Core)	3	3 <sub>1</sub>	30	70	100
MB105	Seminar	--	--	--	--	--
<b>PRACTICALS</b>						
MB 151	General Microbiology & Virology	4	8	--	100	100
MB 152	Biochemistry & Research Methodology	4	8	--	100	100
	<b>Total</b>	<b>20</b>	<b>28<sub>3</sub></b>	<b>120</b>	<b>480</b>	<b>600</b>

  
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**M. Sc. I Semester Microbiology (CBCS)**  
**Paper II Virology (Core) (CBCS)**  
**(7 Hrs per week = 5 credits)**

**Unit I**

History of virology (latest Scientific investigations), Viral classification: Baltimore, Recent changes to virus taxonomy, ICTV-Virosphere and Hierarchical ranks. Viral metadata resource, viral metagenomics-Virome. Virus structure and morphology. Detection of viruses: physical, biological, serological and molecular methods. Cultivation and quantification of bacteriophages, plant and animal viruses. Sub-viral particles: structure, replication and diseases caused by satellites virus, viroids and prions. Significance of emerging viruses: Ebola, Nipah, Hantavirus, Zika virus. General idea about cyanophages, actinophages and mycophages.

**Unit II**

Viral replication Strategies: Cellular interactions—clathrin coated pits, lipid rafts, endocytosis and virus uncoating mechanisms. Host response to viral infection-apoptosis, necrosis, stress response. Cellular basis of transformation, types of cytopathic effects.


Structure, characteristics and replication strategies of Bacteriophages: T2 and Lambda; Structure, characteristics and replication strategies of ds DNA viruses-Adenoviridae, Baculoviridae; ss DNA virus Geminiviridae, Nanoviridae-BBTV; ssDNA/ds DNA virus-Pleolipoviridae, Reverse transcribing DNA/RNA virus-Hepadnaviridae-HBV, Retroviridae-HIV; ds RNA viruses-Reovirales; positive sense RNA virus-Virgaviridae-TMV, Coronaviridae- SARS-CoV-2; negative sense RNA virus-paramyxoviridae

**Unit -III**

Recombination in phages, multiplicity reactivation and phenotypic mixing

General account of Tumor virus (RNA and DNA). Viral Interference and Interferons. Classification of interferons. Antiviral agents (chemical) and their mode of actions.

Different types of viral vaccines, Viral vectors used for cloning and sequencing:  $\lambda$  phage, M 13, Retro viruses, CaMV 35S promoter and its application.

  
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## I Semester Paper I MB 151 General Microbiology (Practicals) (CBCS)

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: Biochemical and molecular (demonstration)
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
12. Calculation of generation time of bacteria
13. Study of bacterial growth curve
14. Effect of temperature on microbial growth
15. Effect of pH on microbial growth

### Recommended books

Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.

Microbiology by Gerard J. Tortora, Berdell Ra. Funke and Christine L. Case. Publ: Pearson Education Inc.

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

  
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**M. Sc. I Semester Microbiology (CBCS)**  
**Paper II Virology (Core) (CBCS) Practicals**

1. Isolation of *E. coli* phage from soil
2. Isolation of *E. coli* phage from sewage
3. Isolation of phages from contaminated food samples
4. Application of bacteriophages as food preservatives
5. Quantification of phages
6. Cultivation and preservation of phages
7. Growth phages of phage and burst size (Demonstration)
8. Phage induction demonstration
9. Cultivation of animal viruses in egg allantoic, amniotic and CAM
10. Symptomatic observations of plant viral infections
11. Demonstration of cytopathological changes of animal virus
12. Study of pathogenic lesions of animal virus diseases through slides.
13. Application of NPV and its role as biopesticide.
14. Visit to lab for NPV production
15. Awareness and participation in vaccination programs (extension activity).

**Recommended Books**

- Recent publications: Research papers and review articles from Google search engine
- General Virology by Luria and Darnel
- Basic Virology. E.K. Wagner
- Virology and Immunology by Jokli
- Laboratory manual of Microbiology and Biotechnology by Aneja, KR
- 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 Christensen
- 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
- Text book of Virology by Rhodes and Van Royan
- Principle of Virology: Molecular Biology, pathogenesis and control of animal viruses.

  
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**M.Sc. Microbiology I Semester (CBCS)**  
**Paper III Research Methodology & Techniques (Core) (CBCS)**  
**(7 Hrs per week = 5 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.  
Chromatographic techniques – HPLC, FPLC paper, thin layer, ion exchange, gel filtration and affinity chromatography.  
Diffusion, dialysis, cell disruption methods, centrifugation techniques. Radio isotopes – detection and measurement of radioactivity – scintillation counters, autoradiography, stable isotopes and their use. Safety precautions.

**Unit II**

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 III**

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. Introduction to Machine Learning and Artificial Intelligence in Microbiology Domain

  
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Circular dichroism, NMR, ESR spectroscopy, x-ray diffraction, types of mass spectrometry.  
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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.

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**I Semester Practical Paper III**  
**Research Methodology and Techniques (CBCS)**

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

Biostatistics – A manual of statistical methods for use in Health, Nutrition and Anthropology by K. Vishveshwar Rao

  
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**M.Sc. Microbiology I Semester (CBCS)**  
**Paper IV Microbial Biochemistry (Core) (CBCS)**  
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**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.

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.

**Unit II**

Nucleic acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides.

Metabolism of purines and pyrimidines - Biosynthesis and degradation

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 III**

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.



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**I Semester Practical Paper IV  
Microbial Biochemistry (CBCS)**

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
7. Quantitative estimation fructose
8. Determination of saponification value of fats
9. Partial purification and assay of  $\beta$ -amylase
10. Partial purification and assay of urease
11. Partial purification and assay of catalase
12. Effect of substrate concentration and time on enzyme activity
13. Effect of pH and temperature on enzyme activity
14. Calculation of  $K_m$  for partially purified enzyme
15. Study for inhibition of enzyme activity

**Recommended Books**

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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



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