

SYLLABUS FOR B.Sc. MICROBIOLOGY (GENERAL) DEGREE PROGRAM UNDER CBCS W.E.F 2017-18
OF SEM I & II

<u>Course Structure for B.Sc (General) Microbiology Degree Program</u>				
PAPER CODE	TITLE		CREDITS	TOTAL
SEMESTER I				
MIC GC 1	Microbiology and Biochemistry I	Theory	4	6
		Practical	2	
MIC SUBJECT 2		Theory	4	6
		Practical	2	
MIC SUBJECT 3		Theory	4	6
		Practical	2	
AECC 1	English / EVS / MIL communication	Theory	4	4
SEMESTER II				
MIC GC 2	Microbiology and Biochemistry II	Theory	4	6
		Practical	2	
MIC SUBJECT 2		Theory	4	6
		Practical	2	
MIC SUBJECT 3		Theory	4	6
		Practical	2	
AECC 1	English / EVS / MIL communication	Theory	4	4

SEMESTER - I

MIC GC-1: MICROBIOLOGY AND BIOCHEMISTRY – I

THEORY

CREDITS: 4

TOTAL HOURS: 60

Unit 1 History of Development and Scope of Microbiology

No. of Hours: 18

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Leeuwenhoek, Pasteur, Koch, Lister, Fleming.

Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology: Contributions of Beijerinck, Winogradsky, Waksman.

Establishment of fields of medical microbiology and immunology through the work of Ehrlich, Metchnikoff, Jenner.

An overview of Scope of Microbiology.

Unit 2 Cell organization

No. of Hours: 06

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili.

Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Gram staining mechanism, lipopolysaccharide (LPS).

Cell Membrane: Structure, function and chemical composition of bacterial cellular membrane.

Endospore: Structure, formation, stages of sporulation.

Unit 3 Bacteriological techniques

No. of Hours: 05

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation of pure cultures; cultivation of anaerobic bacteria.

Unit 4 Microscopy and Principles of staining

No. of Hours: 03

Bright Field Microscope, mordants, fixatives and decolorisers, definition of dyes, chromogen, chromophore and auxochrome group, types of staining – Gram staining, monochrome staining and negative staining.

Unit 5 Growth and nutrition

No. of Hours: 06

Nutritional requirements in bacteria and nutritional categories.

Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential.

Physical methods of microbial control: heat, low temperature, filtration, desiccation, osmotic pressure.

Chemical methods of microbial control: types of disinfectants.

Unit 6 Macromolecules

No. of Hours: 16

Carbohydrates

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose.

Disaccharides; concept of reducing and non-reducing sugars, Haworth projections of maltose, lactose and sucrose.

Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan.

Lipids: Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids: structure and functions. Essential fatty acids. Triacyl glycerols structure, Structural lipids. Phosphoglycerides: Building blocks, General structure.

Proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Protein structure: Primary, secondary, tertiary and quaternary structures.

Nucleic acids: Structure of nucleotides, DNA and RNA; brief concept of central dogma of molecular biology.

Unit 7 Enzymes

No. of Hours: 06

Classification of enzymes. Apoenzyme, coenzyme, prosthetic group, cofactors. Structure of enzyme.

Mechanism of action of enzymes: active site, activation energy, transition state complex.

Multienzyme complex: pyruvate dehydrogenase; Isozyme: lactate dehydrogenase.

PRACTICALS

CREDITS: 2

TOTAL HOURS: 60

1. Microbiology Good Laboratory Practices (GLP) and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation; synthetic media, Complex media-Nutrient agar, MacConkey agar.
4. Simple staining, negative, Gram staining.
5. Isolation of pure cultures of bacteria by streaking method.
6. Estimation of CFU count by spread plate method/pour plate method.
7. Motility by hanging drop method.
8. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non-reducing sugars.
9. Qualitative/Quantitative tests for lipids and proteins.

SUGGESTED READING (Latest editions)

- Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education
- Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition
- Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill International
- Atlas RM. Principles of Microbiology. W.M.T.Brown Publishers.
- Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.

- Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan
- Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson Education Limited
- [Salle](#) A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education
- Modi H.A, Elementary Microbiology Vol I, Fundamentals of Microbiology
- Nelson DL and Cox MM. Lehninger Principles of Biochemistry. W.H. Freeman and Company.
- Voet, D. and Voet J.G. Biochemistry. John Wiley and Sons.
- Conn E and Stumpf P. Outlines of biochemistry. John Wiley and Sons.

SEMESTER - II

MIC GC-2: MICROBIOLOGY AND BIOCHEMISTRY – II

THEORY

CREDITS: 4

TOTAL HOURS: 60

Unit 1 Nature and Properties of Viruses

No of Hours: 08

Introduction: Discovery, nature, definition and general properties of viruses.

Structure of viruses: Capsid symmetry, enveloped and non-enveloped viruses.

Isolation, purification and cultivation of viruses.

Unit 2 Microbial Growth and Effect of Environment on Microbial Growth **No. of Hours: 12**

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate.

Microbial growth in response to environment -temperature (psychrophiles, psychrotrophs, mesophiles, thermophiles, thermodurics), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophiles), oxygen (aerobes, anaerobes, microaerophilic, facultative aerobes, facultative anaerobes), hydrostatic pressure (barophiles).

Microbial growth in response to nutrition and energy – autotroph/phototroph, heterotroph; photoorganoheterotroph, chemolithotroph: chemolithoautotroph, chemolithoheterotroph, chemoheterotroph, photolithoautotroph.

Unit 3 Nutrient uptake and transport

No. of Hours: 05

Passive and facilitated diffusion.

Primary and secondary active transport, concept of uniport, symport and antiport.

Group translocation.

Unit 4 Chemoheterotrophic Metabolism – Aerobic respiration

No. of Hours: 12

Concept of aerobic and anaerobic respiration, fermentation.

Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, TCA cycle.

Electron transport chain: components of respiratory chain.

Unit 5 Chemoheterotrophic Metabolism - Anaerobic respiration and fermentation

No. of Hours: 05

Fermentation - Alcohol fermentation and Pasteur effect; lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

Unit 6 Eukaryotic Cell Structure and functions

No. of Hours: 18

Eukaryotic cell organelles: nucleus, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes, protein sorting and transport, cytoskeleton and cell movement, the plasma membrane.

Signal transduction – Receptors involved in signal transduction, extracellular matrix and cell interactions.

Introduction to cell signalling: components of various signalling pathways, downstream effects of signalling on cell adhesion, cellular differentiation, cell cycle and apoptosis.

Stem cells and their applications.

PRACTICALS

CREDITS: 2

TOTAL HOURS: 60

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Effect of temperature on growth of *E. coli*.
4. Effect of pH on growth of *E. coli*.
5. Effect of salt on growth of *E. coli*.
6. Demonstration of alcoholic fermentation.
7. Demonstration of the thermal death time and decimal reduction time of *E. coli*.
8. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.
9. Study of a plant cell using microscopy.
10. Study of an animal cell using micrographs.
11. Study of the structure of cell organelles through electron micrographs.
12. Cytochemical staining of DNA (Feulgen stain).
13. Identification and study of cancer cells by photomicrographs.

SUGGESTED READING (Latest Editions)

- Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Molecular Biology of The Cell. Garland science, Taylor and Francis group.
- Carter J and Saunders V. Virology: Principles and Applications. John Wiley and Sons.
- Cooper GM and Hausman RE. The Cell: A Molecular Approach. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- De Robertis EDP and De Robertis EMF. Cell and Molecular Biology. Lipincott Williams and Wilkins, Philadelphia.
- Dimmock NJ, Easton AL and Leppard KN. Introduction to Modern Virology. Blackwell Publishing Ltd.
- Flint SJ, Enquist LW, Krug RM., Racaniello VR. and Skalka AM. Principles of Virology, Molecular biology, Pathogenesis and Control. ASM press Washington DC.
- Gottschalk G. Bacterial Metabolism. Springer Verlag
- Levy JA, Conrat HF and Owens RA. Virology. Prentice Hall publication, New Jersey.
- Lodish H, Berk A, Kaise C, Krieger M, Scott M, Bretscher A, Ploegh H and Matsudaira P. Molecular cell biology .W. H. Francis and company, New York.
- Madigan MT and Martinko JM. Brock Biology of Microorganisms. Prentice Hall International Inc.
- Moat AG and Foster JW. Microbial Physiology. John Wiley and Sons
- Reddy SR. and Reddy SM. Microbial Physiology. Scientific Publishers India.
- Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. General Microbiology. McMillan Press.
- Verma PS. and Agarwal PK. Genetics, Molecular biology, Evolution and Ecology. S. Chand.
- Wagner, E.K. and Hewlett, M.J. Basic Virology. Blackwell Publishing.
- Willey, J.M., Sherwood, L.M., and Woolverton, C.J. Prescott's Microbiology. McGraw Hill Higher Education.