



GUJARAT UNIVERSITY
B.Sc. (Honors) Microbiology Syllabus (as per NEP)
Second Year B. Sc. Semester III, Microbiology
Discipline Specific Course -Core
Effective from June-2024

Learning outcomes

- This syllabus aim to provide students with a comprehensive understanding of the structure, function, and significance of carbohydrates, nucleic acids, proteins, lipids, and vitamins in Microbiology.
- Awareness of the diverse functions of proteins in cells and organisms, including enzymatic catalysis, will improve the understanding of signal transduction, structural support, and immune defense further.
- Ability to explain the physiological roles of vitamins in cellular metabolism, growth, and maintenance of health.
- Ability to explain the roles of lipids in membrane structure, energy storage, and signaling molecules.

Paper Code: DSC-C-MIC-231T

Paper Name: Fundamentals of Microbial Biochemistry

Credits: 04 (04 hrs/ week, Total: 60 hrs)

Unit 1 Chemistry for the Microbiologists and Carbohydrate	(Hr)
A. Chemistry for the Microbiologists	(07)
I Structure of atoms: Ions, Isotopes, atomic number and weight	
II Molecules and Chemical Bond: Ionic bonds, covalent bond and Hydrogen bond	
III Free Energy	
B. Carbohydrates	(08)
I. Sugars: Structures of monosaccharides and their stereochemistry	
II Reactions of monosaccharides	
III Structure and Functions of disaccharides: Sucrose, Maltose and Lactose	
IV Structure and Functions of Polysaccharides: Starch, Cellulose and Peptidoglycan	

Unit 2 Nucleic acid and Protein

A. Nucleic acid (08)

- I. Chemical Composition and structure of Nucleic acid: Sugar, Phosphoric acid, Nitrogenous base: Purines and Pyrimidines
- II. Nucleosides and Nucleotides
- III. [a] Formation of Phosphodiester bond and polynucleotide chain of DNA.
[b] Structure of ds DNA
[c] Functions of DNA
- IV. Types of RNA: Structure and Functions of rRNA mRNA and tRNA.

B. Protein (07)

- I. Structure and properties of amino acids
- II. Formation of peptide Bond and polypeptide chain
- III. Structure of proteins: Primary, Secondary, Tertiary and Quaternary
- IV. Classification of proteins
- V. Functions of Proteins

Unit 3 Enzymes**A. General Introduction of Enzymes (07)**

- I. Physical and chemical properties
- II. Structure of enzymes: Prosthetic group, apoenzyme, coenzyme, cofactors.
- III. Localization of enzymes: Extra cellular and intra cellular
- IV. Nomenclature and classification of enzymes, IUB system of enzyme classification.

B. Enzyme action (08)

- I. Active site and allosteric site of an enzyme
- II. Mechanism of enzyme action and allosteric regulation.
- III. Factors affecting enzyme activity
- IV. Inhibition of enzyme activity: Competitive and Non-competitive

Unit 4 Lipids and Vitamins**A. Lipids (08)**

- I. Types of Fatty Acids
- II. Classification of Lipids.
- III. Essential Fatty acids
- IV. Lipids and Biological membrane

B. Vitamins (07)

- I. Classification of Vitamin and Characteristics with suitable examples
- II. Different Sources of Vitamins
- III. Structure and functions of Vitamin B2 (Riboflavin) and Vitamin B12 (Cobalamin)

Text Books:

1. Rastogi S. C., Biochemistry (2003) 2nd Edition, ISBN: 978-0070527959, Tata McGraw - Hill Education

2. Atlas R M, (1977), Principles of Microbiology, 2nd Edition, Wm. C. Brown Publ. Iowa USA
3. Fundamentals Of Biochemistry (2000) by J L Jain, Sunjay Jain and Nitin Jain, ISBN-10 : 9352838300 S. Chand Publication, New Delhi

URLs/Weblinks for E-content

1.	Carbohydrates	https://www.youtube.com/watch?v=Q8kPQQfdtgY&list=PL0o42GecDaMe4h7oZ22kHC45Cpga9BH8c
2.	Protein	https://www.youtube.com/watch?v=YWEiQIEUFak&list=PLRdQ4XybtNjRjIIIVcoCMcwN36BIgPDqw&index=3 https://www.youtube.com/watch?v=kDmOM_sggtc&list=PLRdQ4XybtNjRjIIIVcoCMcwN36BIgPDqw&index=6 https://www.youtube.com/watch?v=Fp1wKo72b2A&list=PLRdQ4XybtNjRjIIIVcoCMcwN36BIgPDqw&index=4
3.	Enzymes	https://www.youtube.com/watch?v=KCG5fDKr9HQ&list=PLRdQ4XybtNjRjIIIVcoCMcwN36BIgPDqw&index=9 https://www.youtube.com/watch?v=IG4uMKtftLI
4.	Nucleic acid	https://www.youtube.com/watch?v=s1MoBTecVYY
5.	Lipids	https://www.youtube.com/watch?v=ZqoX2W1N6I0
6.	Vitamins	https://www.youtube.com/watch?v=dtCvYfhzPQ0 https://www.youtube.com/watch?v=fnkjrUZLFi0

B.Sc. (Honors) Microbiology Syllabus
Second Year B. Sc. Semester III, Microbiology
Discipline Specific Course -Core

Paper code: DSC-C-MIC-232T

Paper name: Microbial growth and physiology

Credits: 04 (04 hrs/ week, Total: 60 hrs)

Learning Outcomes

By the end of the course, the students will be able to:

- Know in detail about the nutrition, growth pattern and environment of a bacterial cell.
- Understand how to control bacterial growth.
- Understand the structure and mode of action of different antibiotics.

Unit:1 Microbial Nutrition and Growth

Teaching hrs: 15

[A] Modes of Nutrient uptake and Transport:

Entry of nutrients in cell, Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation

[B] Culture media: Components of Media,

Natural and Synthetic media, Chemically Defined Media, Complex media, Selective, Differential, Indicator, Enriched and Enrichment media, Transport media

[C] Bacterial Growth

I. Reproduction of bacterial cells: Binary Fission, cell Elongation, DNA Replication, Septum Formation.

II. Normal Growth Curve of Bacteria (phases of growth), Calculation of Generation time and Growth Rate

[D] Measurement of Microbial growth, Cell mass and Cell numbers

[E] Batch culture, Continuous culture, Synchronous Growth, Diauxic Growth Curve

Unit: 2 Effect of Environment on Microbial Growth and Cell Communications

Teaching hrs: 15

[A] Microbial growth in response to environment –

I. Temperature (Psychrophiles, Mesophiles, Thermophiles, Thermodurics, Psychrotrophs),

II. pH (Neutrophiles, Acidophiles, Alkaliphiles),

III. Oxygen (Aerobic, Anaerobic, Microaerophilic, Facultative anaerobe),

IV. Salt/Sugar/Solute and Water activity (Halophiles, Xerophiles, Osmophilic),

V. Hydrostatic Pressure: Barophiles.

[B] Biofilms, Cell-Cell communication, Inter domain Communication

Unit: 3 Principles of Microbial control**Teaching hrs: 15**

- [A] General Principles: Control by killing, inhibition, and removal
- [B] Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation
- [C] Chemical methods of microbial control: Ideal antimicrobial agent
- [D] Major groups, types and mode of action: Disinfectants and antiseptics, surfactants (phenols), Halogens, Alcohols, Heavy metals, Gaseous agents.

Unit: 4 Chemotherapeutic agents**Teaching hrs: 15**

- [A] Principles of chemotherapy
- [B] Chemical structure and mode of action of antibiotics
 - I. Inhibition of cell wall synthesis (Penicillin G)
 - II. Inhibition of membrane functions (Polymyxin b)
 - III. Inhibition of DNA synthesis (Ciprofloxacin)
 - IV. Inhibition of RNA synthesis (Rifamycin B)
 - V. Inhibition of protein synthesis and Enzymes (Streptomycin and Sulfonamides)

Text Books:

1. Microbiology, Pelczar JR., Chan ECS, Krieg NR, 5th Edition (1993), McGraw-Hill Book Company, NY.
2. Principles of Microbiology, R. M. Atlas, 2nd Edition (Indian Edition) (2015) McGraw Hill Education (India) Private Limited, New Delhi, India.
3. Microbiology, Prescott, Joanne Willey, Kathleen Sandman and Dorothy Wood, 5th Edition (1993), McGraw-Hill Book Company, NY.

URLs/Weblinks for E-content

4. Binary fission in bacteria <https://youtu.be/XICA-cdvSvU?si=cMyUvzwaZocXDNI9>
5. Bacterial Growth curve https://youtu.be/JpnH_6kqvdw?si=D26WwgdinyE_xwg5
6. Measurement of Growth <https://youtu.be/2fbwCsCxmt4?si=tCUwQRc0QBjNltP6>
7. Types of culture media <https://youtu.be/mE9PRcBJWdo?si=-F0J0GkWw2qQ-eCJ>
- 8 Effect of temperature on bacterial growth https://youtu.be/cmHZWaxndsU?si=JdG_qtrUmRqDwckK
9. Factors affecting microbial growth <https://youtu.be/N1DaPuO5gRY?si=Izgf9oOK4LZ93vH1>
10. Biofilm <https://youtu.be/2AQ6iLmo0h0?si=iVt6HhTLyCoIoJ6I>
11. Physical methods of microbial control <https://youtu.be/eVafcIVWzdM?si=zumV1xwFn8nS2P9u>
12. Chemical methods of microbial control <https://youtu.be/mu6JFX3WkmA?si=TXRFiL178Jpcgwed>
13. Inhibition of cell wall synthesis <https://youtu.be/eoHWobPU6C4?si=rUMfOq9r8HUOXoro>
14. Inhibition of cell membrane synthesis <https://youtu.be/3otG8ic14kk?si=ErPZQGz0qv08gnhL>
15. Inhibition of DNA synthesis <https://youtu.be/IENaBxJBW78?si=OPqy6zt9xIC8JPu9>
16. Inhibition of RNA synthesis <https://youtu.be/1i5h1OCA6i4?si=-uiIDUDPK9hXF6Ge>
17. Inhibition of protein synthesis <https://youtu.be/FfSqugAKF7I?si=dFBSM7SaPJTehjmn>

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Effective from June-2024
Paper Code: DSC-C-MIC-233P
Paper Name: Microbiology Practicals
Credits: 04 (08 hrs/ week, Total: 60 hrs)

1. Study of different types of media
 - A. Selective media: Rose Bengal agar medium
 - B. Differential medium: MacConkey's agar medium, EMB agar medium, Triple sugar iron agar medium
 - C. Enrichment media: Selenite broth
 - D. Enriched media: Blood agar medium
 - E. Natural media: Soil extract agar medium,
2. Qualitative analysis of biomolecules
 - A. Carbohydrates: Iodine test, Molisch's test, Benedict's test, Barfoed's test, Bial's test and Seliwanoff's test
 - B. Protein: Biuret test, Ehrlich's test, Glyoxylic acid test and Xanthoproteic test
 - C. Qualitative analysis of lipids –Sudan IV Dye test, Solubility test, Saponification test, Potassium permanganate test for unsaturated fatty acids
3. Study of effect of antimicrobial compounds on growth of bacteria
 - A. Study of effect of heavy metal on growth of bacteria
 - B. Study of effect of chemicals (5% phenol, 1% crystal violet and 0.001% HgCl₂) on growth of bacteria (Agar cup method)
 - C. Study of effect of antibiotics on growth of bacteria using paper disc method
 - D. Study of effect of antibiotic on growth of bacteria using agar ditch method
4. Study of normal growth curve of *E. coli* (Demonstration only)
5. Study of effects of environmental factors on growth on microorganism (Tube method)
 - A. Study of effect of Temperature on growth of *E. coli*
 - B. Study of effect of pH on growth of *E. coli*
 - C. Study of effect of NaCl concentration on growth of *E. coli*
6. Study of biochemical reactions
 - A. Based on utilization of carbon source
 - I. Fermentation of sugars:
 - (a) Broth media: Glucose, Xylose, Mannitol

(b) Agar media: TSI agar slant

- II. Detection of glucose break-down products: Methyl red test and Voges Proskauer's test
- III. Citrate utilization test
- IV. Starch utilization test

B. Based on utilization of nitrogen source

- I. Indole production test
- II. H₂S production test
- III. Urea utilization test
- IV. Gelatine Hydrolysis test
- V. Deamination test
- VI. Ammonia production test
- VII. Nitrate reduction test

C. Based on enzymes: Dehydrogenase test, Catalase test and Oxidase test