

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
(Formerly West Bengal University of Technology)
Syllabus of B. Sc in Microbiology
(Effective from 2023-24 Academic Sessions)

Graduate Attributes

By the end of the program the students will be able to:

- The course is emphasized on morphology, physiology and function of microorganisms in addition to several subjects including biochemistry, cell biology, immunology, virology, molecular biology and recombinant DNA technology.
- On successful completion of graduation, the students will gain insight of microbiology starting from history, basic laboratory techniques and fundamental knowledge about the microorganisms.
- They will acquire the skill in the use and care of basic microbiological equipment; performance of basic laboratory procedures in microbiology; proper collection and forwarding of microbiological and parasitological specimens to the laboratory.
- They will be well-informative about the integral role of microorganisms associated with specific disease, the concepts of microbial infections in animals & plants and to implement the acquired knowledge for prevention and control of microbial diseases.
- To learn and apply the standard laboratory techniques in the field of environmental, agricultural and industrial microbiology.
- To gain an in-depth idea on cellular metabolic activities in molecular level and their application to develop recombinant organisms.
- To understand the knowledge of developing the basic procedure of food production, therapeutic agents, metabolites, proteins and other beneficial products through recombinant micro-organisms.
- The skill enhancement elective course is designed to provide students with an opportunity to gain hands on experience in state-of-the-art laboratory equipments that could enrich them to perform high throughput research on microorganisms and execute diagnostic procedures required in food, dairy and pharmaceutical industries.
- This course will also help students to comprehend and write effective project reports in multidisciplinary environment. It will also help to the development of sound attitudes in relation to the role of medical microbiology in clinical and community medicine.

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FIRST SEMESTER

Course Name: An Introduction to Basic Microbiology

Mode: Offline

Credits: 5(3T+2P)

BMMC-1101

Aim of the Course:The aim is to achieve background and basic knowledge of the fundamentals of Microbes

Course Objectives:The course is aimed to know about the history and development of microbiology, different types of microorganism, their general features and the scope of microbiology.

Sl	Graduate attributes	Mapped modules
CO1	To gain a preliminary idea about the Microbiology, the contribution of eminent scientists, developments in the field of Microbiology. Idea about the future scope of Microbiology	M1
CO2	Idea about the characteristics of different groups of acellular and cellular microorganisms.	M2
CO3	To familiarize with various growth pattern of microbes along with their phases and growth curve. Also able to learn factors influencing microbial growth.	M3
CO4	To develop the interest in the control measures of pathogens and concept of sterilization.	M4
CO5	Knowledge on staining techniques to observe the microbial morphology and intracellular structures under microscopes.	M5
CO6	To learn the concept of media preparation for microbial culture, maintenance and preservation/stocking of pure cultures.	M6

Learning Outcome/ Skills:

The candidates should demonstrate fundamental knowledge about microbiology. They will be also able to understand how microbiology was developed. The students will be aware of microbial cell structure, observation and measure of microbial growth pattern, microbial identification, culturing methods and sterilization techniques. This paper is also important to understand the scope of Microbiology.

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Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	History and Scope of Microbiology , Contributions of eminent scientists	10	20	1,2	NA
M2	Diversity and characteristics of the different groups Microorganisms	8	10%	1,2,3	NA
M3	Bacterial reproduction and the factors influencing microbial growth	8	15%	1,2	NA
M4	Sterilization and methods of microbial control: disinfectants, types and mode of action. Phenol coefficient. Concept of sanitization,	5	15%	1,2,3	NA
M5	Basic Principles of Microscopy and Staining for Sample preparation	8	20%	2,3,4	NA
M6	Bacteriological techniques cultivation, maintenance and preservation/stocking of pure cultures	6	20%	2,3,4	NA
Total Theory		45	100		
<u>Practical</u>		30			
TOTAL		75			

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Detailed Syllabus

Module 1: History and Scope of Microbiology

Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander 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 Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner; Emerging fields and future scope of Microbiology.

Module 2: Diversity of Microorganisms

Characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya: Algae, Fungi and Protozoa) giving definitions and citing examples Protozoa.

Module 3: Reproduction in Bacteria

Asexual methods of reproduction, Binary fission and its consequences, types of growth. Phases of bacterial growth and growth curve. Factors influencing microbial growth.

Module 4: Sterilization

Sterilization - dry and moist heat, tyndallization pasteurization, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation, ultrasonication
Chemical methods of microbial control: disinfectants, types and mode of action. Phenol coefficient. Concept of sanitization, antiseptics, fumigation.

Module 5: Basic Principles of Microscopy and Staining

Principle of Bright and Dark Field Microscope, Electron Microscope;
Stains and staining techniques: Definition of auxochrome, chromophores, dyes, Principle and procedure of different classes of staining: Negative staining, Differential staining (Gram stain, Acid fast stain, Endospore stain, Capsule stain and Flagella stain); Sample preparation for Electron microscope)

Module 6: Bacteriological techniques

Chemically defined media, Complex media. Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria.

PRACTICAL

Credit: 2

Total Hours: 30

BMMC 1191

1. Microbiology Laboratory Management and Biosafety.
2. 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. Sterilization of medium using Autoclave and assessment for sterility
4. Sterilization of glassware using Hot air Oven and assessment for sterility
5. Sterilization of heat sensitive material by filtration and assessment for sterility
6. Determination of phenol coefficient of disinfectants
7. Study of different shapes of bacteria using permanent slides
8. Study of *Rhizopus* and *Penicillium* using permanent mounts
9. Study of *Spirogyra* and *Chlamydomonas* using permanent Mounts

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10. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*

Suggested Readings:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGrawHill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGrawHill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

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Course Name: Cell Biology

Mode: Offline
BMMC-1102

Credits: 5(3T+2P)

Aim of the Course: The aim is to achieve Basic knowledge of the fundamentals of cell structure and basic knowledge of different functions.

Course Objectives: The course is aimed to build knowledge in fundamentals of cell Biology, the basic concepts of the components of prokaryotic and eukaryotic cells. It also considers how cells function. Upon completion of this course, students should understand the basic knowledge underlying cell cycle and develop an understanding of apoptosis or cell death. They should be able to characterize properties of different component of cell systems and relate them with different functions

Sl	Graduate attributes	Mapped modules
CO1	To acquaint students with basic knowledge of Cell Biology, Historical perspectives- Discovery of cell and Cell Theory	M1
CO2	Students will learn about the structure and organization of Prokaryotic Cell and different cellular organelles.	M1
CO3	Students will get a concept on Comparison between plant and animal cells, cell compartmentalization, cell fractionation as well as the basics of Cell Membrane and Permeability .	M2
CO4	The student shall get a detailed concept of structure, function biogenesis of Membrane, Vacuolar system, cytoskeleton and cell motility, microtubules, Microfilaments, Intermediate filaments. ER, Golgi complex etc.	M3
CO5	Students will be acquainted with the structure, function and biogenesis of Lysosomes and microbodies, Structure and functions Ribosomes, Mitochondria. Chloroplasts, Nucleus	M4
CO6	The student shall master the knowledge about Eukaryotic Cell cycle and its regulation; cell division, Programmed cell death, Apoptosis and its relation with Cancer.	M6

Learning Outcome/ Skills:

The candidates should demonstrate fundamental knowledge and insight into cell biology and they will be also able to understand problems related to the structure of cell organelles, their functions and importance.

Knowledge and understanding should be demonstrated in the areas of: cell membranes, their permeabilities, cell divisions and apoptosis related knowledges.

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Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	Basic knowledge of Cell Biology, Historical perspectives- Discovery of cell and Cell Theory	3	6	1	NA
M2	Structure and organization of Prokaryotic Cell and different cellular organelles.	7	10	1,2	NA
M3	Comparison between plant and animal cells, cell compartmentalization, cell fractionation, Cell Membrane and Permeability	5	14	1,2,3	NA
M4	Structure, function biogenesis of Membrane, Vacuolar system, cytoskeleton and cell motility, microtubules, Microfilaments, Intermediate filaments. ER, Golgi complex.	9	20	1,2,3	NA
M5	Structure, function and biogenesis of Lysosomes and microbodies, Structure and functions Ribosomes, Mitochondria. Chloroplasts, Nucleus	9	25	2,3	NA
	Eukaryotic Cell cycle and its regulation; cell division, Programmed cell death, Apoptosis in relation with Cancer	12	25	2,3,4	
Total Theory		45	100	1, 2, 3,4	NA
<u>Practical</u>		30			<u>NA</u>
TOTAL		75			<u>NA</u>

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Detailed Syllabus

Module 1:

Basic knowledge of Cell Biology

Basic knowledge of Cell Biology, Historical perspectives- Discovery of cell and Cell Theory

Total Hours: 3

Module 2:

Structure and organization of Prokaryotic Cell

Structure and organization of Prokaryotic Cell: Prokaryotic Cell size, shape and arrangement, glycocalyx: capsule and slime layer, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Gram staining mechanisms, Unique cell wall structure of Acid fast bacteria, sphaeroplasts, protoplasts, and L-forms. Composition of Archaeobacterial cell wall and cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. Endospore: Structure, formation and stages of sporulation.

Total Hours: 7

Module 3:

Comparison between plant and animal cells

Comparison between plant and animal cells; cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Cell wall; Plasma membrane; Modification of plasma membrane; Extra cellular matrix and cell matrix interactions, Cell Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects); Protoplasm.

Total Hours: 5

Module 4:

Membranes and organelles:

Membrane, Vacuolar system, cytoskeleton and cell motility : Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

Total Hours: 9

Module 5:

Ribosomes, Mitochondria, chloroplast, Nucleus

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis, Nucleus: Structure and function, chromosomes and their structure.

Total Hours:9

Module 6:

Cell cycle, Cell division, Apoptosis

Eukaryotic Cell cycle and its regulation; cell division -Mitosis and Meiosis; Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer.

Total Hours: 12

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PRACTICAL

Credit: 2

Total Hours: 30

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of Mitotic Chromosome from onion root tip.
2. Preparation of Meiotic Chromosome from *Rhoeo discolor* or onion sp.
3. Preparation and study of polytene chromosome from *Drosophila* salivary gland.
4. Study of sex chromatin through preparation of Barr body from buccal epithelium .
5. Study of plasmolysis and de-plasmolysis.

Suggested Readings:

1. Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. The Cell: A Molecular Approach (7th Edition), Geoffrey M. Cooper, Robert E. Hausman.
4. Essential Cell Biology, Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D.Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.
5. Cell Biology, Genetics, Molecular Biology, P.S.Verma