GOKUL GLOBAL UNIVERSITY

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(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

BACHELOR OF SCIENCE

MICROBIOLOGY

Faculty of Science
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B. Sc Semester I Teaching scheme

Sr No	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total marks
							Internal	External	
1	Foundation Compulsory	B101FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC101U DSC	Introduction to Microbial world	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT101U DSC	Botany	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE101U DSC	Inorganic, Organic, Physical & Volumetric	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT101U PRA	Botany practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC101U PRA	Microbiology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE101U PRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BMIC101U SE	Subject Elective: Application of Microbiology	2	0	2	15	35	50
9	Elective Generic	B101EG	Elective Generic: Communication Skills	2	0	2	0	50	50
		Total credit		18	12	24	135	515	650

B. Sc Semester II Teaching scheme

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total marks
							Internal	External	
1	Foundation Compulsory	B201FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT201 UDSC	Biomolecules and Cell Biology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC201 UDSC	Systematic Bacteriology	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE20 1UDSC	Inorganic, Organic, Physical Chemistry	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT201 UPRA	Botany Practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC201 UPRA	Microbiology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE20 1UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BMIC201 USE	Subject Elective:History of microbiology	2	0	2	15	35	50
9	Elective Generic	B201UE G	Elective Generic: Disaster Management	2	0	2	0	50	50
		Total credit		18	12	24	135	515	650

B. Sc Semester III Teaching scheme

							Examination		Total Marks
Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Internal	External	
1	Foundation Compulsory	B301FC	Foundation Compulsory - English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT301UDSC	Mycology and Phytopathology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT302UDSC	Archegoniate	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC301UDSC	Microbial physiology and metabolism	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC302UDSC	Soil and water Microbiology	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT301UPRA	Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BMIC301UPRA	Microbiology practical	0	6	3	0	100	100
8	Subject Elective	BMIC301USE	Microbial analysis of air and water	2	0	2	15	35	50
9	Elective Generic	B301UEG	Elective Generic: Personality Development	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

B. Sc Semester IV Teaching scheme

							Examination		Total Marks
Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Internal	External	
1	Foundation Compulsory	B401FC	Foundation Compulsory - English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT401U DSC	Anatomy of Angiosperms	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT402U DSC	Economic Botany	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC401U DSC	Microbial biodiversity	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC402U DSC	Food and dairy microbiology	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT401U PRA	Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BMIC401U PRA	Microbiology practical	0	6	3	0	100	100
8	Subject Elective	BMIC401U SE	Food fermentation Techniques	2	0	2	15	35	50
9	Elective Generic	B401EG	Elective Generic: Human Rights	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

B. Sc Semester V Teaching scheme

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total marks
							Internal	External	
1	Foundation Compulsory	B501FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC501U DSC	Molecular Biology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC502U DSC	Immunology	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC503U DSC	Classical genetics	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC504U DSC	Gene transfer Techniques	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BMIC501U PRA	Practical Module I	0	6	3	0	100	100
		BMIC502U PRA	Practical Module II	0	6	3	0	100	100
8	Subject Elective	BMIC501U SE	Hematology and blood banking	2	0	2	15	35	50
9	Elective Generic	B501EG	Environment and Sustainable Development	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

B. Sc Semester VI Teaching scheme

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total marks
							Internal	External	
1	Foundation Compulsory	B601FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC601U DSC	Medical Microbiology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC602U DSC	R-DNA technology	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC603U DSC	Industrial Microbiology	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC604U DSC	Bioprocess Technology	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BMIC601U PRA	Practical Module I	0	6	3	0	100	100
		BMIC602U PRA	Practical Module 2	0	6	3	0	100	100
8	Subject Elective	BMIC601U SE	Instrumentation and Biotechniques	2	0	2	15	35	50
9	Elective Generic	B601EG	Stress Management	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

BMIC101UDSC: INTRODUCTION TO MICROBIAL WORLD

Objective: To complement the students with the basic knowledge about history and scope of microbiology, general characteristics of microorganisms, various microscopic techniques, physical and chemical microbial control.

CREDITS: 04

Unit	Topic	Content	Hrs.	Weightage
1		**Why Microbiology?**	15	25%
	1.1	Microbiology as a field of Biology.		
	1.2	Where exact Microorganisms in living world.		
	1.3	Binomial Nomenclature, Haeckel's Three Kingdom and Whittaker's five Kingdom classification, Prokaryotic and Eukaryotic classification.		
	1.4	Group of microorganisms (Acellular and cellular microorganisms)		
2		**History of Microbiology**	15	25%
	2.1	Spontaneous generation Versus biogenesis, Germ theory of disease.		
	2.2	Development of various microbiological techniques and golden era of Microbiology		
	2.3	Development of various microbiological techniques and contributionof Anton Von Leeuwenhoek , Louis Pasture , Robert Koch , Josehp Lister , Alexander flaming, Selman A. Waksman, Sergei N. Winogradsky, Paul Ehrlich, Edward Jenner, Elie Metchnikoff…		
	2.4	Microbiology and modern biology, Microbiology and society.		
3		**General Characteristics of Microorganisms**	15	25%
	3.1	Characteristics of Microorganisms: Morphological, Chemical, Cultural, Metabolic, Antigenic, Genetic, Phylogenetic and Ecological.		
	3.2	Microbial Identification, Classification and Nomenclature.		
	3.3	General characteristics, occurrence, structure, reproduction and importance of protozoa.		
	3.4	General characteristics, occurrence, structure, reproduction and importance of fungi.		
4		**Microbial Techniques**	15	25%
	4.1	**Microscopy:** Bright field microscopy, Dark field Microscopy, Phase Contrast Microscopy		

4.2	Fluorescence microscopy, Transmission electron microscopy, Scanning Electron Microscopy		
4.3	**Microbial Control:** A) Physical method: Moist Heat, Dry Heat, Tyndallization, Filtration, And Radiation. B) Chemical Method		
4.4	Beneficial and harmful microbes and their role in daily life. Concept of disease in plant and animal caused by microorganism.		

Reference Books

1. Prescott's Microbiology by Joanne Willey and Linda Sherwood
2. Brock Biology of Microorganisms, by Michael T. Madigan and John M. Martinko
3. Microbiology: A Systems Approach by Marjorie Kelly Cowan
4. Foundations in Microbiology by Kathleen Park Talaro and Barry Chess
5. Microbiology by Pelczar, Jr., Michael
6. Microbiology by Jacquelyn G. Black A Textbook of Microbiology

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate theory in microscopy and their handling techniques and staining procedure.
CO2	Know Various characteristics of microorganisms and also understand various physical and chemical means of sterilization.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	1	-	3	1	-	3	2	-	-	-
CO2	3	2	1	-	2	2	-	3	2	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	3	1	-	3	2	-	-	-	3	-
CO2	3	2	1	-	2	2	-	3	2	-	-	-	2	-

BMIC101USE: APPLICATION OF MICROBIOLOGY

Objective: 1. To Study various applications of microbiology in various field.

2. To complement the students with the basic knowledge about Recombinant DNA technology, Genetic Engineering, Bioleaching, Production of Enzymes, antibiotics etc.

CREDITS: 02

Unit	Topic	Content	Hrs.	Weightage
1		**Applied areas of Microbiology-1**	15	50%
	1.1	Applications of Microbiology in the field of agriculture.		
	1.2	Applications of Microbiology in the field of medicines.		
	1.3	Applications of Microbiology in the field of Dairy & Food Industries.		
2		**Applied areas of Microbiology-2**	15	50%
	2.1	Biotechnology, Recombinant DNA Technology & Genetic Engineering , Ecology & Environment, Pollution Control & Bioremediation .		
	2.2	Bioleaching, Aeromicrobiology & Exomicrobiology Pharmaceutical Microbiology, Veterinary Microbiology.		
	2.3	Fermentation Industries (Production of Antibiotics, Organic Acids, Enzymes & Other Specialty Biochemicals).		

Reference Books

1. Microbiology by M.J.Pelczar, ECS Chan & NR Krieg

2. Principles of Microbiology by R.M. Atlas
3. Microbiology by Presscott, Harley & Klein
4. Elementary Microbiology Vol.-1 by H.A.Modi
5. Textbook of Microbiology by R.C.Dubey & D.K.Maheshwari

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge about application of microbiology in medicines, dairy and food industries, agriculture, Pharmaceutical industries.
CO2	Students will gain knowledge about Recombinant DNA, Vector, Plasmids, Fermentative production of Penicillin, Amylase, and Bioremediation.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**3**	**1**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**1**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**3**	**1**	**2**	**2**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**1**	**2**	**2**

BMIC101UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 02

LIST OF EXPERIMENTS

1. Microbiology Good laboratory practices and biosafety.
2. To study the principle and application of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, microscope, pH meter) used in microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Sterilization of medium using Autoclave and assessment for sterility.
5. Sterilization of glassware using Hot Air Oven and assessment for sterility.
6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility.
7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
8. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts.
9. Study of Spirogyra and Chlamydomonas, Volvox using temporary mounts.
10. Study of the following protozoans using permanent mounts/photograph: Amoeba, Paramecium and plasmodium.

BMIC201UDSC: SYSTEMATIC BACTERIOLOGY

Objective: To complement the students with the basic knowledge about bacterial cell organization, bacterial reproduction, pure culture isolation and preservation, microbial nutrients, various staining methods.

CREDITS: 04

Unit	Topic	Content	Hrs	Weightage
1		**Bacterial cell Organization**	15	25%
	1.1	Bacterial cell size, Shape and Arrangement.		
	1.2	Composition and details structure of Flagella, Fimbriae and Pili, Capsule, Structure, function and chemical composition of bacterial and archaeal : Cell Wall and Cell Membrane.		
	1.2 a	Cytoplasm: Ribosome, Mesosomes, Inclusion Body, Nucleoid, Chromosome and Plasmid.		
	1.3	Spore: Structure, Formation, and Stage of sporulation.		
2		**Bacterial Reproduction**	15	25%
	2.1	Asexual methods of Reproduction		
	2.2	Logarithmic representation of bacterial population and phase of bacterial growth.		
	2.3	Calculation of time and specific growth rate		
	2.4	Factors affecting microbial growth.		
3		**Microbial Nutrient**	15	25%
	3.1	Bacterial nutrition requirement and categorization.		
	3.2	Introduction to culture media.		
	3.3	Different types of microbial culture media.		
4		**Pure Culture Isolation and Preservation**	15	25%
	4.1	Introduction to term: Pure culture, Mix culture, Microbial strain, Microbial colony,		
	4.2	Selection of microbial Diversity from different source.		
	4.3	Laboratory techniques: Serial Dilution, Streak plate method, Spread plate method and Pour plate method.		
	4.4	Methods for Maintenance and Preservation of bacterial culture,		

Reference Books

1. Prescott's Microbiology by Joanne Willey and Linda Sherwood

2. Brock Biology of Microorganisms, by Michael T. Madigan and John M.Martinko

3. Microbiology: A Systems Approach by Marjorie Kelly
Cowan 4.Foundations in Microbiology by Kathleen Park Talaro
and Barry Chess
5. Microbiology by Pelczar, Jr., Michael

6. Microbiology by Jacquelyn G. Black

7.A Textbook of Microbiology by Dubey R.C. and Maheshwari D.K.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge about bacterial cell size , shape, arrangement, detail structure of flagella, pilli, cell wall, cell membrane.
CO2	Students will gain knowledge about sexual and asexual bacterial reproduction, Bacterial Growth curve, Different type of culture media.
CO3	Demonstrate theory in laboratory and their handling techniques and staining procedure.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	-	-	-	2	1	-	2	1	-	-	-
CO2	3	1	-	-	2	1	-	2	2	-	-	-
CO3	3	3	-	-	2	1	-	3	3	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	-	-	-	2	1	-	2	1	-	-	-	3	-
CO2	3	1	-	-	2	1	-	2	2	-	-	-	2	-
CO3	3	3	-	-	2	1	-	3	3	-	-	-	3	-

BMIC201USE: HISTORY OF MICROBIOLOGY

Objective: To complement the students with the basic knowledge about Invention of microscope, abiogenesis and biogenesis theory, contribution of various scientist.

CREDITS: 02

Unit	Topic	Content	Hrs.	Weightage
1		**History of Microbiology-1**	15	50%
	1.1	History & Invention of Microscope by Anton van LeeuwenHoek, Theory of Abiogenesis (Spontaneous Generation).		
	1.2	Scientists that helped in disproving the theory of spontaneous generation , Contributions of Louis Pasteur: Pasteurization, Vaccination & others.		
	1.3	Contributions of Robert Koch: Germ Theory of the Disease, Koch's Postulates, Discovery of Methods for Isolation & Pure Culture techniques.		
2		**History of Microbiology-2**	15	50%
	2.1	Discovery of Antibiotics: Alexander Fleming & Penicillin.		
	2.2	Role of Microorganisms as a causative agent of the disease Microorganisms and Fertility of Soil.		
	2.3	Discovery of Viruses , Golden era of Microbiology.		

Reference Books

1. Microbiology by M.J.Pelczar, ECS Chan & NR Krieg
2. Principles of Microbiology by R.M. Atlas
3. Microbiology by Presscott, Harley & Klein
4. Elementary Microbiology Vol.-1 by H.A.Modi
5. Textbook of Microbiology by R.C.Dubey & D.K.Maheshwari

Course Outcomes: At the end of the course, students shall be able to

CO1	Student will gain knowledge about spontaneous generation, pasteurization, Vaccination, Lytic and lysogenic cycle of virus.
CO2	Students will gain knowledge about Germ theory of disease, pure culture technique, Penicillin.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**1**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**1**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**1**	**2**	**1**

BMIC201UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 02

LIST OF EXPERIMENTS

1. Simple staining
2. Negative staining
3. Gram's staining
4. Acid fast staining- permanent slide only
5. Capsule staining
6. Endospore staining
7. Preparation of differential media
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Motility by hanging drop method.
11. Estimation of CFU count by spread plate method and pour plate method.

BMIC301UDSC: MICROBIAL PHYSIOLOGY AND METABOLISM

Objective: To Understand the knowledge about Enzymes, co factors, apo enzyme, Microbial growth, Aerobic respiration and fermentation.

CREDITS: 03

Unit	Topic	Content	Credit	Weightage
1		**ENZYMES**	1	33.3%
	1.1	General introduction : Physical and chemical properties, Structure of enzymes: prosthetic group, apoenzyme, coenzyme, cofactors.		
	1.2	Localization of enzymes : Extra cellular and intra cellular, Nomenclature and classification of enzymes, IUB systemof enzyme classification.		
	1.3	Enzyme action: active sites of enzyme, Mechanism of enzyme action.		
	1.4	Factors affecting enzyme activity, Inhibition of enzyme activity: Competitive and noncompetitive.		
2		**Microbial nutrition and Growth**	1	33.3%
	2.1	Nutritional categories of microorganisms: carbon, Energyandelectron donor source.		
	2.2	Culture media: principles of media formulations. Types of media : Routine and specialized media, selective media, differential media, Enriched and Enrichment media, Assay media.		
	2.3	Methods of reproduction in bacteria and new cell formation.		
	2.4	Principles of chemotherapy and general mode of action ofvarious chemotherapeutic agent: Sulphonamides, antibiotics and semi synthetic antibiotics.		
3		**Biomolecules and metabolism**	1	33.3%
	3.1	Biomolecules: Chemical structure, properties, classification, and biological significance of Carbohydrate,Proteins, lipid and nucleicacids. Introduction to modes of microbial metabolism: Anabolism,catabolism, primary and secondary metabolism.		
	3.2	Concept of aerobic respiration, and fermentation sugar degradation pathways i.e. EMP, ED, pentose phosphate pathway, TCA cycle. Electron transport chain, Gluconeogenesis, cori cycle		

	3.3	Anaerobic respiration : Anaerobic respiration with special referenceto dissimilatory nitrate reduction, Anaerobic fermentation: Alcohol fermentation and Pasteur effect, Lactate fermentation.		

Reference Books

1 Microbiology by Pelczar, Jr., Michael

2 General Microbiology stainer R.Y , ingram, Eheelies, M.L. painter, Mac Million India.

3 Introduction to microbiology, J.L, ingram and C.A. Ingram

4 Microbiology, J.G. Black, Edition 5th

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge of competitive, non-competitive inhibition of enzyme, Media formulation, Enzyme classification, Chemotherapy.
CO2	Students will also study EMP, TCA, Pentose Phosphate pathway, Alcohol fermentation, lactate fermentation, Importance of carbohydrates, proteins, lipids, nucleic acid.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	**Program Outcomes**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**2**	**-**	**-**	**-**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**2**	**-**	**-**	**-**	**2**	**1**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**2**	**1**

BMIC302UDSC: SOIL AND WATER MICROBIOLOGY

Objective: To Study Physicochemical properties of soil, soil microflora, Biochemical transformation in soil, Bacteriological examination of drinking water, Types of waste water, Microbial interaction.

CREDITS: 03

Unit	Topic	Content	Credit	Weightage
1		**MICROBIOLOGY OF SOIL**	1	33.3%
	1.1	Physicochemical properties of soil, soil as a culture medium.		
	1.2	Microbial flora of Soil, Role of microorganisms in soil: Mineralization and humus formation.		
	1.3	Methods of studying soil micro flora: Direct microscopic method, agar plate technique, enrichment culture technique, and buried slide method, Molecularmethods for study of Soil microorganism.		
	1.4	Microbial interactions and associations in soil:(i) Neutral, Positive (Symbiosis, Mutualism, Syntrophism, Commensalism, Synergism) and Negative(Antagonism, Competition, Parasitism, Predation) associations, Interaction between plant roots and microorganisms: Rhizosphere and its significance, (ii) Mycorrhiza.		
2		**MICROORGANISM AS BIOGEOCHEMICAL AGENT**	1	33.3%
	2.1	Introduction to biogeochemical transformations in soil: Mineralization and immobilization of elements.		
	2.2	Rotation of elements in nature, Nitrogen cycle:Proteolysis, ammonification, nitrification, denitrification and nitrogen fixation. Sulfur cycle: Sulfur oxidation and reduction, Carbon cycle, Degradation of complex organic compounds, carbon dioxide fixation.		
	2.3	Iron cycle: Iron oxidation and reduction. Phosphorus cycle: Mineralization, immobilization andsolubilization of phosphorus		
	2.4	Soil fertility: Role of microorganisms in soil fertility, biofertilizers		
		MICROBIOLOGY OF DRINKING WATER AND WASTEWATER		
	3.1	Natural waters: Sources of contamination, Microbial indicators of faecal pollution: Coliforms as indicator Microbial indicators other than Coliforms. Nuisance organisms in water: Slime forming bacteria, iron and sulfur bacteria and algae.		

3	**3.2**	Bacteriological examination of drinking water: Sampling,Quantitative analysis : Standard Plate Count.Qualitative analysis: Multiple tube fermentation Purification of drinking water: Sedimentation, filtrationand disinfection, softening of hard water, use of Reverse Osmosisprocess.		
	3.3	Types of wastewater, chemical and microbiological BOD, COD and TOC as indicators of strength ofwastewater Methods of wastewater treatment: Primary treatment and secondary treatment. Principles and role of microorganismstrickling filters, activated sludge process, oxidation ponds.		
	3.4	. Efficiency of wastewater treatment procedures		

Reference Books

1 Microbiology by Pelczar, Jr., Michael
2 Modi H A., (2013), Soil Microbiology, Aavishkar Publishers, Jaipur.
3 Atlas R M., (1997), Principles of Microbiology. 2nded. Wm. C. Brown Pub., Iowa, USA
4 Alexander M, (1977), Soil Microbiology, 2nded Krieger Publ. Co., Melbourne, FL.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will study about role of microorganisms in soil, role of microorganisms in sulphar cycle, iron cycle, phosphorus cycle, nitrogen cycle.
CO2	Students will also learn about Quantitative & Qualitative analysis of drinking water, filtration, sedimentation, Primary and secondary waste water treatment procedure.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	**3**	**1**	**2**	**-**	**1**	**2**	**-**	**2**	**1**	**-**	**-**	**-**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**1**	**-**	**-**	**-**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**1**	**2**	**-**	**1**	**2**	**-**	**2**	**1**	**-**	**-**	**-**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**1**	**-**	**-**	**-**	**2**	**1**

BMIC301USE: MICROBIAL ANALYSIS OF AIR AND WATER

Objective: To complement the students with the basic knowledge about air sample collection and analysis, Water sample collection and quantitative and qualitative analysis of water.

CREDITS: 02

Unit	Content		Credit	Weightage
I	**Air microbiology** 1.1 Bioaerosols, air borne microorganisms and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens. 1.2 Air sample collection and Analysis: Bioaerosol sampling, air samplers method of analysis CFU, culture media for bacteria and fungi. 1.3 Fate of bioaerosols, inactivation mechanisms- UV light, HEPA filters, desiccation, incineration		1	50%
II	**Water microbiology** 2.1 Water borne pathogens, water borne diseases. 2.2 Microbial analysis of water: sample collection, treatment and safety of drinking water, methods to detect potability of water sample (a) standard qualitative procedure (b) Membrane filter techniques (c) presence/absence tests. 2.3 Control measures: precipitation, chemical disinfection, filtration, high temperature, UV light.		1	50%

Reference Books:

1. Da silva N, Taniwaki MH, Junqueria VC, silveria N, Nascimento MS, Gomes RAR (2012) Microbiological examination methods of food and water.

2. Microbial Ecology, Atlas RM and Bartha R.

3. Environmental microbiology, Maier RM. Pepper IL and Gerba CP. (2009) 2nd edition

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate theory in Laboratory for SPC, MPN, Membrane filter technique.
CO2	Students will gain knowledge about air born microorganisms impact on human health, its importance in pharma and food industries and inactivation mechanisms (UV light, desiccation etc), water born diseases.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	1	-	2	2	-	3	3	-	-	-
CO2	3	1	1	-	2	2	-	3	2	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	2	2	-	3	3	-	-	-	2	1
CO2	3	1	1	-	2	2	-	3	2	-	-	-	1	2

BMIC301UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 03

LIST OF EXPERIMENTS

1) Qualitative analysis of biomolecules:

A) Carbohydrates: Iodine test, Molisch's test, Benedict's test, Barfoed test, Bial's test and Saliwanoff's test.

B) Proteins: Biurate test, Ehrlich"s test, Glyoxilic acid test, Xanthoproteic test

2) Determination of absorption maxima of a colored solution (use methylene blue).

3) Study biochemical reaction of bacteria.

(A) Based on carbon source.

i. Oxidative and fermentative breakdown of glucose.

ii. Fermentation of sugars and sugar alcohol: glucose, xylose, mannitol, lactose, maltose and sucrose.

iii. Glucose breakdown product: Methyl red test.

iv. Citrate utilization test.

v. Starch utilization test.

vi. Lipid utilization test.

(B) Based on nitrogen source.

I. Indole production test.

II. H2S production test.

III. Urea utilization test.

IV. Casein hydrolysis test.

V. Gelatin hydrolysis test.

VI. Deamination test.

(C) Other tests.

I. Catalase test.

II. Dehydrogenase test.

III. Oxidase test

4) Microbiological analysis of soil.

(A) Enumeration of organisms from soil (standard plate count-Soil).
(B) Isolation of symbiotic & non-symbiotic nitrogen fixing bacteria & actinomycetes from soil.

5) Microbiological analysis of drinking water.

(A) Standard plate count of drinking water.

(B) Determination of MPN of coliforms in water
(C) Detection of fecal pollution of water by performing presumptive test, confirmed testand completed test

6) Determination of DO from the water sample.

7) Study of ingredient used in culture media: Agar, peptones, amino acids, antibiotics, beef extract, bile salt, blood, casein hydrolysate, water, dyes ,gelatin, inorganic salts, meat extract, yeast extract.

8) Study of effect of antibiotics on bacteria :
(A) Study of sensitivity spectrum of antibiotics against the test organism by use of paperdisc method and Agar ditch method.

BMIC401UDSC: MICROBIAL BIODIVERSITY

Objective: To complement the students with the knowledge about Biodiversity of Microorganisms, Methods for Biodiversity assessment.

CREDITS: 03

Unit	Content		Credit	Weightage
I	**INTRODUCTION TO BIODIVERSITY & METHODS OF ASSESSING BIODIVERSITY** 1.1 What is biodiversity? Origin of life, evolution and origin of biodiversity,species concept. 1.2 Evolutionary tree of microorganisms. Value of biodiversity, microbial biodiversity asindex of environmental change 1.3 . Microscopic methods: Basic microscopy and microscopic analysis in microbial diversity assessment. Cultural methods: Biochemical /Metabolite methods. 1.4 Molecular and genomic methods: Molecular context of microbial diversity Importance of DNA and r-RNA sequence comparison, determination of GC content		1	33.33%
II	**DIVERSITY AMONGST BACTERIA** 2.1 Morphological and cellular diversity: Diversity in major cell shape and grouping. Diversity in ultra- structure of cell with reference to cell envelope, Cell membrane, cell wall, surface appendages, other cell organelles and spore. 2.2 Physiological and metabolic diversity. Diversity in photosynthetic, heterotrophic and autotrophic metabolism. 2.3 Ecological diversity: Diversity in major ecosystems. 2.4 Diversity in aquatic, marine and extreme environment.		1	33.33%
III	**BIODIVERSITY AMONG EUKARYOTIC AND ACELLULAR MICROORGANISMS** 3.1 Eukarya: Morphological, cellular, physiological, metabolic and ecological characteristics of Protozoans and Slime molds. 3.2 Morphological, cellular, physiological, metabolic and ecological characteristics of Fungi and Algae. 3.3 Lichens as consortium of algae and fungi. 3.4 Acellular organisms: Viroids and prions.		1	33.33%

Reference Books:

1. Modi H.A., (2014), Introductory Microbial world, Shanti Prakashan, Ahmedabad.
2. Atlas R M, Bartha R, (1998), Microbial Ecology: Fundamentals & Applications. 4th edn. Pearson Education.
3. Ogunseitan O., (2005) Microbial Diversity: Form and Function in Prokaryotes, Blackwell Publishing, Malden, MA, Oxford, Victoria.
4. Cambell R., (1983), Microbial Ecology, 2ndedn. Blackwell Scientific Publication.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge of evolution and origin of biodiversity, Biochemical, Molecular, Genomic and metabolic cultural methods, Evolutionary tree.
CO2	Students will Study Physiological, metabolic, Morphological, Cellular and ecological diversity, Lichens.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**	**2**	**-**	**2**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**2**	**-**	**2**	**1**	**2**	**2**	**2**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**2**	**1**	**2**	**2**	**2**	**2**	**1**
CO2	**3**	**2**	**2**	**-**	**2**	**1**	**2**	**2**	**2**	**2**	**1**

BMIC402UDSC: FOOD AND DAIRY MICROBIOLOGY

Objective: To complement the students with the knowledge about Food born infection, food born poisoning, food spoilage by microbes and their preservations

CREDITS:03

Unit	Content		Credit	Weightage
I	**MICROBES IN FOOD BORNE INFECTION AND POISONING** 1.1 Food as a substrate for microorganisms Microbial flora of foods: Milk, fruits, vegetables meat, eggs. 1.2 Factors affecting kinds and numbers of microorganisms: intrinsic and extrinsic 1.3 Food and milk borne infections Sources of contamination and Major food and milk borne diseases. 1.4 Food poisoning: *A.* Microorganisms involved, sources of contamination. *B.* Role of *Staphylococcus aureus, Clostridium botulinum* and *Salmonella spp*. *C.* Molds as poisoning agents		1	33.33%
II	**MICROBIAL FOOD SPOILAGE AND PRESERVATION** 2.1 Microbial Spoilage of food: Causes of spoilage. Biochemical changes due to microbes. 2.2 Spoilage of milk and milk products, fruits, vegetables, eggs, meat Spoilage of canned foods. 2.3 Preservation of food and Milk: General principles 2.4 Methods of preservation: i. Use of aseptic handling. ii. High temperature: Pasteurization(with Phosphatase), sterilization, canning. iii. Low temperature: Refrigeration and freezing.		1	33.33%
III	**USE OF MICROBES IN FOOD PRODUCTS AND THEIR METHODS** 3.1 Fermented dairy products Starter culture, Cheese: Types,		1	33.33%

	curdling, processing, ripening. Other fermented dairy products Yogurt, cultured buttermilk, Kefir and cultured sour milk. Introduction to probiotics, prebiotics and synbiotics, functional foods. 3.2 Indian fermented food products: Pickles, idli, Khaman and bread. Microbes as food: Mushrooms, spirulina and yeasts. 3.3 Biological methods: Generalized scheme for microbiological examination. Direct microscopic examination, colony forming units (CFU), Most probable number (MPN), 3.4 Bacteriological analysis of milk: Grading of milk - Resazurin test. Determination of efficiency of pasteurization:Phosphatase test.			

Reference Books:

1. Frazier W C and Westhoff D C (1988). Food Microbiology, 4th ed. McGraw-Hill, NY
2. Modi H.A., (2009). Dairy Microbiology, Aavishkar Publishers, Jaipur
3. Prescott L, Harley J P, and Klein D A, (2008). Microbiology, 7th ed. Wm C. Brown McGraw Hill, Dubuque IA
4. Pelczar Jr, M J, Chan E C S, Krieg N R, (1986). Microbiology: An Application Based Approach, 5th edn. McGraw-Hill Book Company, NY.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about microbial flora of food , Major food born disease, Pasteurization, sterilization, canning, Refrigeration, Freezing.
CO2	Students will gain knowledge about Staphylococcus aureus food poisoning, Botulism, Biochemical changes in food by microbes, Role of microbes in kefir , kumiss, pickles, importance of probiotics, Bacteriological analysis of food by CFU and MPN.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**1**	**2**	**-**	**2**	**2**	**-**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**2**	**2**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**1**	**2**	**-**	**2**	**2**	**-**	**2**	**1**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**2**	**2**	**2**	**1**

BMIC401USE: FOOD FERMENTATION TECHNIQUES

Objective: To complement the students with the knowledge about Food born infection, food born poisoning, food spoilage by microbes and their preservations

CREDITS: 02

Unit	Topic	Content	Credit	Weightage
1		**Fermented foods-I**	1	50%
	1.1	Defination, types, advantages and health benefits.		
	1.2	Milk based fermented food: Dahi, yogurt and cheese, preparation of inoculums, types of microorganisms and production process.		
	1.3	Grain based fermented food: Soy sauce, bread, idli and Dosa: microorganisms and production process.		
2		**Fermented food- II**	1	50%
	2.1	Vegetable based fermented food- Pickels, Saeurkraut: microorganisms and production process.		
	2.2	Fermented Meat and fish: microorganisms and production process.		
	2.3	Probiotic foods: Defination, types, microorganisms and health benefits.		

Reference Books

1. Frazier W C and Westhoff D C (1988). Food Microbiology, 4th ed. McGraw-Hill, NY
2. Holzapfel W (2014) Advances in fermented food and beverages
3. Yadav JS, Grover S and Batish VK (1993) A comprehensive dairy microbiology
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food microbiology, 7th edition Springer

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about the different types of fermentation processes, equipment's used and microbiological processes involved.
CO2	Students will gain knowledge of significance and activities of microorganisms in food.
CO3	Students will gain knowledge about microbiology of milk & fermented products.
CO4	Students will also know the microbial quality control and quality schemes used in food industries.
CO5	Students will gain knowledge about microbiology of grain & vegetables based fermented foods, Microbiology of fermented meat and fish, & Probiotics foods.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	1	-	2	2	-	2	2	-	-	-
CO2	3	-	2	-	2	1	-	2	2	-	-	-
CO3	3	1	2	-	2	1	-	2	2	-	-	-
CO4	3	2	2	-	2	2	-	3	2	-	-	-
CO5	3	-	2	-	2	1	-	2	2	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	1	-	2	2	-	2	2	-	-	-	1	2
CO2	3	-	2	-	2	1	-	2	2	-	-	-	2	1
CO3	3	1	2	-	2	1	-	2	2	-	-	-	1	1
CO4	3	2	2	-	2	2	-	3	2	-	-	-	1	1
CO5	3	-	2	-	2	1	-	2	2	-	-	-	1	1

BMIC401UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 03

LIST OF EXPERIMENTS

(1). Study of ecological diversity amongst bacteria:

A. cultivation of acidophilic and alkaliphilic bacteria.

B. cultivation of halophilic and non halophilic bacteria.

C. cultivation of thermophilic and mesophilic bacteria

(2). Study of morphological and cultural diversity of *Escherichia coli, Enterobacter aerogenes, Staphylococcus aureus, Bacillus subtilis, Bacillus megaterium and Bacillus cereus, S. marcescens.*

A. Study of morphological diversity by performing Gram's staining, capsule staining and spore staining.

B. Study of cultural / growth diversity using nutrient broth and nutrient agar media.

(3). Study of metabolic diversity amongst bacteria: *Escherichia coli, Enterobacter aerogenes, Proteus vulgaris, Staphylococcus aureus, and Bacillus subtilis* by performing various biochemical tests:

I. Based on carbon metabolism

- Methyl Red Test
- Voges-Proskauer (V-P) test,
- Fermentation of sugars and sugar alcohol: glucose, xylose, mannitol, lactose, maltose and sucrose,
- Citrate utilization test,
- Starch utilization test,
- Lipid utilization test.

II. Based nitrogen metabolism.

- Indole production test
- H2S production test

- Urea utilization test,
- Casein hydrolysis test
- Gelatin hydrolysis test.

III. Presence of respiratory enzymes.

- Catalase test,
- Dehydrogenase test,
- Oxidase test.

(4). Microbiological analysis of food:

- Standard plate count of food sample.
- Determination of MPN of coliforms

(5). Microbiological analysis of milk:

- Standard plate count of milk sample.
- Determination of microbial load of milk by use of MBRT of raw milk, boiled milk and pasteurized milk.
- Detection of acid-fast organisms in milk sample.

BMIC501UDSC: MOLECULAR BIOLOGY

Objective:

1. To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.
2. Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development.
3. It is a large and ever-changing discipline.
4. This course will emphasize the molecular mechanisms of DNA replication, repair, protein synthesis

CREDITS: 03

Unit	Topic	Content	Credit	Weightage
1		**Structures of DNA and RNA & Replication ofDNA**	1	33.3%
	1.1	DNA structure: Micscher to Watson and Crick- historic perspective DNA structures, salient features of double helix.		
	1.2	Types of DNA, types of genetic material, denaturation and renaturation, cot curves. DNA topology- linking number, topoisomerases.		
	1.3	Organization of DNA in prokaryotes, viruses,eukaryotes, RNA structure, organelles DNA-mitochondria and chloroplast DNA.		
2		**Replication of DNA**	1	33.3%
	2.1	Bidirectional and unidirectional replication, semi Conservative, semi discontinuous replication. Mechanism of DNA replication.		
	2.2	Enzyme and proteins involved in DNA replication: DNA ligase, primase.		
	2.3	Various models of DNA replication including rolling circle, D-loop (mitochondrial), theta model of replication, other accessory proteins.		
		Transcription & Translational in prokaryotes and Eukaryotes		
	3.1	Transcription: Definition, difference from replication, Transcription in eukaryotes: RNA polymerases, general transcription factors. Post transcriptional processing: split		

3		genes, concept of introns and exons, RNA splicing, spliceosome machinery.	**1**	**33.3%**
	3.2	Translational machinery, charging of tRNA, aminoacyl tRNA synthetases, mechanisms of initiation, elongation and termination of polypeptides in prokaryotes fidelity of translation, inhibitors of protein synthesis in prokaryotes.		
	3.3	DNA methylation and Histone Acetylation mechanisms		

Reference Books

1. Watsan JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecularbiology of the gene, 6th edition, Cold spring Harbour Lab. Press, pearson publication.
2. Becker WM, Kleinsmith Lj, Hardin J and Brtoni GP (2009) The world of the cell, 7thedition, pearson Benjamin Cummings Publishing, san Francisco.
3. Karp G (2010) Cell and Molecular Biology, Concepts and experiments, 6th edition.John Wiley & Sons. Inc.
4. Gardner EJ, Simmons MJ, Snustad DP (2008) Principles of Genetics. 8th Ed. Wiley-India.

Course Outcomes: At the end of the course, students shall be able to

CO1	Molecular Biology gives you in-depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms
CO2	You will gain an understanding of chemical and molecular processes that occur in and between cells

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	1	2	3	2	2	-	3	1	-	-	-
CO2	1	2	3	-	3	2	-	2	1	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	2	3	2	2	-	3	1	-	-	-	2	**1**
CO2	1	2	3	-	3	2	-	2	1	-	-	-	1	**1**

BMIC502UDSC: IMMUNOLOGY

Objective:

(a) To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.
(b) Demonstrate the basic knowledge of immunological processes at a cellular and molecular level.
(c) Define central immunological principles and concepts.
(d) The key mechanisms and cellular players of innate and adaptive immunity and how they relate.

CREDITS: 03

Unit	Content	Credit	Weightage
I	**Introductiontoimmunology** 1.1 Concept of innate and adaptive immunity,contributions of various scientists to the development of field of immunology. 1.2Immune cells: structure, function of immune cells-stem cell,T cell, B cell,NK cell, Macrophage, Neutrophil, Eosinophil, Basophile, Mast cell, Dendritic cell. 1.3Immuneorgans:Bonemarrow,Thymus,Lymphnode, spleen, GALT, MALT, CALT.	1	33.33%
II	**Antigen andAntibody** 2.1Antigen: Characteristics of an antigen, Haptens, Epitopes,T dependentand T independent antigens,Adjuvants. 2.2Antibody: Structure, Types, function and properties of antibodies,antigenic determinantson antibodies,monoclonal and chimeric antibodies. 2.3 Major Histocompatibility Complex: Organization of MHC locus ,structure and function of MHC Iand II molecules.	1	33.33%
III	**ImmunologicalTechniques,Responseand Disorders** 3.1 Principles of precipitation, Agglutination, Immuno diffusion, immune electrophoresis ELISA, Western Blotting. RIA, Immuno fluorescence Complement system: Components of the complement system, classical and alternative pathways 3.2Immune response: Primary and secondary immune eresponse,Generation of Humoral and cell mediated Immune response.	1	33.33%

	3.3 Immunological Disorders: Types of autoimmunity, autoimmune diseases, Hypersensitivity (Type-I, Type-II, Type-III, Type-IV).Immunodeficiencies: primary immunodeficiency, and secondary immunodeficiency.		

Reference Books:

1. Immunology: byIMRoitt,J.Brostoffand DKMale(1993) BMP,London.
2. JKuby(1991).Immunologyfreemanandcompany.
3. A.K.Abbas,A.H.Uchtman,J.S.Pober(1994).CellularMolecularimmunology-W.B.SaundesCo.Philadelphia.

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate theory in microscopy and their handling techniques and staining procedure.
CO2	Know Various characteristics of microorganisms and also understand various physical and chemical means of sterilization.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**2**	**1**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**3**	**1**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**2**	**1**	**2**	**1**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**3**	**1**	**2**	**1**

BMIC503UDSC: CLASSICAL GENETICS

Objective: To complement the students with the basic knowledge about Genetics, importance of genetics, Mendalian genetics, Gene, Genome, Chromosome mapping.

CREDITS: 03

Unit	Content		Credit	Weightage
I	**Information about Genetics & MendelianPrinciples** 1.1 Overview of genetics. The relationship between Genes and traits. Fields of genetics. 1.2 Principles of inheritance relevance of Mendelian laws. Mendel's genetics: Segregation of two or more genes, The principles of independent assortment. 1.3 Dihybrid test crosses, Mendelian inheritance andprobability		1	33.33%
II	**Genes and chromosomes** 2.1 Nature of genetic material, gene structure andfunction. 2.2 The stability of chromosomes complement, Mitosis-Meiosis, chromosomes and heredity. 2.3 Determination of X-linked inheritance, sex determination in drosophila.		1	33.33%
III	**Genetic linkage and chromosome mapping** 3.1 Linkage and recombination of genes in a chromosome, Genetic mapping- crossing over, crossing over takes place at the four strand stage ofmeiosis. 3.2 The molecular basis of crossing over, multiplecrossing over, Genetic mapping for three point- test Crosses double crossing over, genetic mapping andfunctions- genetic distance and physical distance. 3.3 Introduction of tetrad analysis method of genetic Mapping, Mitotic recombination- Recombinationwithin genes closer look at complementation.		1	33.33%

Reference Books:

1. Genetics: principles and analysis. 4 th addition, Denial L Hartl, Elizabeth tones.
2. Principles of genetics: E.J Gardner
3. Genes 9: Benjamin Levin

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn relationship between genes and traits, various fields, law of dominance, independent inheritance, monohybrid and dihybrid cross, low of segregation, Probability, chi-square analysis.
CO2	Students will gain knowledge about basics of gene, genome, Chromosomes and its types, centromere, sex determination in drosophila, Mitosis, meiosis, types of crossing over, tetrad analysis.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	1	2	-	2	2	-	3	1	-	-	-
CO2	3	-	1	-	2	2	-	2	1	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	2	-	2	2	-	3	1	-	-	-	1	1
CO2	3	-	1	-	2	2	-	2	1	-	-	-	2	1

BMIC504UDSC: GENE TRANSFER TECHNIQUES

Objective: To study the basics of Recombination's, bacterial plasmids, Bacterial transformation, transduction and conjugation in *E.coli*.

CREDITS: 03

Unit	Content		Credit	Weightage
I	**Principles of Gene transfer** 1.1 Bacterial recombination: General Principles, Introduction To genetic recombination and its biological significance, types of recombination and their molecular mechanisms: Generalized, site-specific and illegitimate recombination, recombination frequency and its significance. 1.2 Bacterial plasmids- fertility factor,Transfer of plasmid DNA – In vitro plasmid transfer – plasmid replication 1.3 Properties of particular bacterial plasmids, f - plasmids, R-plasmids, colicinogenic plasmid, Stringent plasmid, Agrobacterium plasmid Ti –broad, host range plasmid.		1	33.33%
II	**Transformation & Transduction** 2.1 Introduction of transformation, Molecular mechanism of transformation. Mapping by transformation, other uses bytransformation 2.2 Generalized transduction, Co transduction and linkage, Mapping by co-transduction. 2.3 Specialized transduction, Formation of specialized Transducing particle from lambda lysogen, Specialized transduction of a non lysogen. Specialized transduction of a lysogen.		1	33.33%
III	**Conjugation** 3.1 Insertion of F-into the E.coli chromosome Hfr transfer, Interrupted matting and time of entry mapping. 3.2 HFr mapping and HFr collection, Mapping Unselected Recessive markers, Chromosomes transfer by F^+ cultures. 3.3 Isolation of Hfr strains, Rec A- protein and itsfunction.		1	33.33%

Reference Books:

1. Principles of Genetics : Eighth Edition. 1991, John Wiley & Sons by GARDNER,Simmons snustand.
2. Microbial Genetics, Second Edition 1994. Stan ely R. Maloy, John E. Cronar, D. Arcidfreifelder, Johnes & Barlett publishers.
3. Microbiology: second Edition 1993, Lansing M. Harl ey , Donald A. Klein.Win C.Brown publishers
4. Textbook of Biotechnology by R. C. Dubey, Publisher : S. Chand, and Co
5. Biotechnology by S.S.Purohit.
6. Genetic Engineering by Sandhya Mitra
7. Fundamentals of Molecular Biology 2009, Tar ganti K. Pal, Saroj S.
8. Molecular Cell Biology 5 th edition by Lodish, Berk, Matsudalia
9. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. BlackwellPublishing, Oxford,U.K.
10. Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge about principle of recombination and its types, and their molecular mechanisms, in vitro plasmid transfer and plasmid replication, Various plasmids and its properties.
CO2	Students will learn Molecular mechanisms of transformation, Types of transduction, specialized transducing particle formation from lysogen, Hfr transfer, Rec A protein and its function.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**3**	**2**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**3**	**2**	**2**	**1**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**2**	**1**

BMIC501USE: HEMATOLOGY AND BLOOD BANKING

Objective:

- Haematology is the specialty responsible for the diagnosis and management of a wide range of benign and malignant disorders of the red and white blood cells, platelets and the coagulation system in adults and children.
- Haematologists care directly for patients on hospital wards and out patient clinics.

CREDITS: 02

Unit	Content		Credit	Weightage
I	**Introduction to hematology and Bloodandwith its components** 1.1 Introduction: Hematology, Blood,Plasma and serum. 1.2 Redbloodcells, Whitebloodcell and Platelets with its functions 1.3 Morphology and General Hematology 1.4 Hemostasis and Thrombosis in Laboratory		1	50%
II	**BloodtransfusionandTransfusionreactions** 2.1 Collection,storageandtransfusionofblood. 2.2 Bloodgrouping. 2.3 Majorandminorcrossmatching. 2.4 ErythroblastosisFoetalis.		1	50%

Reference Books:

1. Clinical pathology Hematology and blood banking by Nanda Maheshwari, JaypeeBrothersMedicalpublishers.
2. EssentialofHematology3rdedition(2020)ByShirishMKawthalkar.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about blood grouping, Major and minor cross matching, blood transfusion and collection.
CO2	Students will gain basic knowledge about blood, plasma, serum, WBC and RBC.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**
CO2	**3**	**1**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**2**	**2**
CO2	**3**	**1**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**2**	**1**

BMIC501UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 03

LIST OF EXPERIMENTS

1) Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer. (A_{260} measurement).
2) Resolution and visualization of DNA byAgarose Gel Electrophoresis.
3) Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
4) Preparation and Identification of different cell types in peripheral blood
    a. Total count of WBC
    b. Total count of RBC
    c. Differential Count of WBC
5) Estimation of Blood Glucose by Glucose Oxidase method.
6) Estimation of Blood Urea by DAM method
7) Determination of human blood groups: ABO and Rh system.
8) Study of Agglutination reaction: i) WIDAL test, ii) Double dilution technique.
9) Estimation Haemoglobin by Sahli's Method.
10) Immunodiffusion techniques.

BMIC502UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 03

LIST OF EXPERIMENTS

1) Demonstration of Bacterial Conjugation.
2) Demonstration of bacterial transformation.
3) Demonstration of bacterial transduction.
4) Isolation of antibiotic resistant mutant(s) bacterium by direct selection (Gradient PlateTechnique).
5) Monohybrid Ratio and its Modification
6) Dihybrid Ratio and its Modification
7) Chi-Square Analysis
8) Estimation of Linkage: Two Point Test Cross
9) Estimation of Linkage: Three Point Test Cross
10) Study of Trihybrid Ratio and back cross methods
11) Isolation of antibiotic resistant mutant(s) bacterium by indirect selection (Replica PlateTechnique).

BMIC601UDSC: MEDICAL MICROBIOLOGY

Objective:

(a) To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.

(b) The course aims to provide students with an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles and functions and inter relations.

CREDITS: 03

Unit	Content		Credit	Weightage
I	**Host Parasite Relationship & Epidemiology** 1.1 Terms: Pathology, Infection, intoxication and disease, symptoms, sign, syndrome, prophylaxis Normal flora of skin, oral cavity, Gastrointestinal tract, and other body region. Toxins – Endotoxins and Exotoxins Nonspecific host defenses – General, physical,chemical and biological barriers. 1.2 Definition - pandemic, epidemic, endemic and sporadic, epizootics and zoonoses, Mortality rate, Immunization, vaccine, adjuvant, serum, antiserum, anamnesis, toxoids, Recognition of Epidemic, antigenic shift and drift, Herd Immunity. 1.3 Transmission of disease: Contact, vehicle and vector Transmission, Nosocomial infections, Control of Epidemics. Types of vaccines –whole organism vaccines, Inactivated, Purified macromolecules as vaccines,Recombinant vector vaccines, DNA vaccines, and multivalent subunit vaccines.		1	33.33%
II	**Systemic diseases I** 2.1 Diseases of Skin and Eyes: Bacterial Viral (Chicken pox and Herpes) and fungal. 2.2 Diseases of Nervous System: Bacterial and Viral (Rabies and Creutzfeldt- Jakob disease) 2.3 Diseases of Cardiovascular and Lymphatic System: Bacterial, Protozooal (Malaria) and Viral (Dengue Fever)		1	33.33%
III	**Systemic diseases II**		1	33.33%

	3.1 Diseases of Respiratory System: Bacterial, Viral (Influenza and Common cold) 3.2 Diseases of Digestive System: Bacterial, Viral (Hepatitis) and Protozooal (Amoebic dysentery.) 3.3 Diseases of Urinary and Reproductive System: Bacterial, Viral (Genital Herpes) and Fungal(Candidiasis).			

Reference Books:

1. Tortora,G.J., Funke,B.R.,Case, C.L. (2001)Microbiology:An Introduction. (7thed). BenjaminCummings N.Y.
2. Prescott, L.M., Harley, J.P., Klein. DA., (2002) Microbiology (5th edY McGraw Hiil. International ed.
3. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
4. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnickand Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
5. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology.4th edition. Elsevier
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
7. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to identify common infectious agents and the diseases that they cause.
CO2	The student will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
CO3	The student will be able to recall microbial physiology including metabolism, regulation and replication

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	2	3	2	1	2	1	1	-	-	-
CO2	2	2	1	1	-	2	-	1	2	-	-	-
CO3	3	1	1	2	-	-	2	2	-	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	1	2	1	1	-	-	-	-	3
CO2	2	2	1	1	-	2	-	1	2	-	-	-	-	1
CO3	3	1	1	2	-	-	2	2	-	-	-	-	2	1

BMIC602UDSC: RECOMBINANT DNA TECHNOLOGY

Objective:

- To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
- To expose students to application of recombinant DNA technology in biotechnological research.

CREDITS: 03

Unit	Content		Credit	Weightage
I	**Introduction and Scope** 1.1 What is genetics engineering? Historical perspectives, Milestone in biotechnology and recombinant DNAtechnology. 1.2 Blotting: Southern blotting, Western blotting, Northern blotting, Colony blotting, Dot blotting.Hybridization and detection of probe using autoradiography (FISH). 1.3 Gene library construction (Genomic & c-DNA library).		1	33.33%
II	**Techniques of Genetic Engineering** 2.1Requirements of molecular biology laboratory Gene cloning in prokaryotes – isolation of DNA to be cloned – insertion of DNA fragments in to vector –use of linkers and adaptors. 2.2 Colony hybridization technique. 2.3 Cloning in eukaryotes in plant cell, yeast, filamentous fungi.		1	33.33%
III	**Methods Of Gene Transfer & Genome Mapping** 3.1Physical (Electroporation, Gene gun- particle bombardment, Microinjection- divert transformation, transformation by ultra sonication Chemical Method (Competent cell preparation, Cacl2 mediated gene transfer, PEG mediated gene transfer) 3.20Molecular markers (RFLP, RAPD, AFLP, SNP, SCAR, SSR, VNTR), Chromosome walking.Polymerase chain reaction techniques: Basic PCR technique,Variation of PCR techniques andApplications of PCR 3.3 Applications of rDNA technology: Gene therapy, Expression of therapeutic proteins, Forensic science,Food, Agriculture		1	33.33%

Reference Books:

1. Principles of gene manipulation. 1994. Old & Primrose. Blackwell Scientific Publications.
2. Molecular cloning. 3 volumes. Sambrose and Russell. 2000. CSH press.
3. Genome analysis. Four volumes. 2000. CSH Press.

Course Outcomes: At the end of the course, students shall be able to

CO1	Technical know-how on versatile techniques in recombinant DNA technology.
CO2	An understanding on application of genetic engineering techniques in basic and applied experimental biology.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**3**	**2**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**2**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**3**	**2**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**2**	**2**	**1**

BMIC603UDSC: INDUSTRIAL MICROBIOLOGY

Objective:

1. Industrial microbiology deals with fermentation process and how these process produced economically important products.
2. It is a large and ever changing discipline
3. This course will emphasize the medium formulation, inoculam development and screening of microorganisms.

CREDITS: 03

Unit	Topic	Content	Credit	Weightage
1		**Introduction to bioprocessing and strain improvement**	1	33.3%
	1.1	Concept of Fermentation (definition and applications), Range of fermentation processes & component parts of fermentation process.		
	1.2	Growth kinetics: Batch, fed-batch and continuous culture (chemostat and turbidostat).		
	1.3	Isolation, Enrichment & screening (Primary & Secondary) of Industrial important microorganisms, Preservation techniques		
2		**Concept of fermentation media and inoculum Development**	1	33.3%
	2.1	Medium formulations for industry and types (crude and synthetic) of fermentation media.		
	2.2	Raw materials used in fermentation media and criteria for selection Sterilization of Media & Air.		

	2.3	Inoculum Development: Typical Inoculum Development program, Inocula development for Bacteria, Yeast and Fungal processes Scale-up.		
3		**Design of fermenter and overview of Downstream Processing**	**1**	**33.3%**
	3.1	Design of fermentor :Basic function of typical fermenter. Types of fermenters: Tower, Cylindroconical, Air lift, Acetator - Cavitator, Bioreactors for animal cell cultures.		
	3.2	Removal of Solid & Microbial Cells and other solid Matter, Precipitation, Filtration and Centrifugation. Cell disruption Concentration of extracted product: Liquid-Liquid extraction, Distillation.		
	3.3	Purification products: Chromatography, Membrane processes and ultra-filtration Drying & Crystallization Quality Assurance-Bioassay.		

Reference Books

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
3. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education .
5. Biotechnology –The Biological Principles, M.D.Trevan ,S.Boffey,K H Goulding, P Stanbury
6. Mukhopadhyay, Process Biotechnology Fundamental. Viva book.
7. Shuler and Kargi, 1992. Bioprocess engineering, Prentice-Hall.
8. Bialy & Ollis.1986. Biochemical Eng. Fundaments. McGraw-Hill.
9. Schugerl. 1987. Bioreaction engineering, J/W.
10. Stanbury and Whitaker. Principles of fermentation technology.
11. Sikyta. Methods in Industrial microbiology. Ellis Hardwood Lt

Course Outcomes: At the end of the course, students shall be able to

CO1	Industrial microbiology gives you in depth knowledge of growth kinetics and strain improvement.
CO2	Student will gain an understanding of chromatography, preservation techniques, Quality assurance bioassay, Draying & Crystallization, Distillation.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	2	-	2	2	-	3	2	-	-	-
CO2	3	2	1	-	2	2	-	3	2	-	-	-

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	-	2	2	-	3	2	-	-	-	1	2
CO2	3	2	1	-	2	2	-	3	2	-	-	-	1	1

BMIC604UDSC: BIOPROCESS TECHNOLOGY

Objective: The course aims to provide students with an understanding of microbial processes in food, primary metabolites like carbohydrates, proteins, vitamins, secondary metabolites like steroids, antibiotics. Bioprocess economics, Scale up.

CREDITS: 03

Unit	Topic	Content	Credit	Weightage
1		**Overview of Microbial Processes and Exploration of microbes for over production of metabolites**	1	33.3%
	1.1	Microbial processes in food- SCP and Yeast. Microbial processes in industry: bioleaching and MEOR. Microbial processes in agriculture: Bio insecticide and bio-fertilizer.		
	1.2	Primary metabolites and strain improvement. Secondary metabolites and strain improvement.		
	1.3	Current advances and future prospects.		
2		**Control parameters and Scale up**	1	33.3%
	2.1	Control systems: Manual and automatic, combined method, requirement for control.		
	2.2	Biosenser, Recent trends in fermentation control.		
	2.3	Scale up of industrial products.		
3		**Bioprocess Economics**	1	33.3%
	3.1	Introduction		
	3.2	Fermentation economics for isolation, strain improvement and media design.		

	3.3	Fermentation economics for sterilization, aeration and agitation and effluent treatments.		

Reference Books

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
3. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education
5. Biotechnology –The Biological Principles, M.D.Trevan ,S.Boffey,K H Goulding, P Stanbury
6. Mukhopadhyay, Process Biotechnology Fundamental. Viva book.
7. Shuler and Kargi, 1992. Bioprocess engineering, Prentice-Hall.
8. Bialy & Ollis.1986. Biochemical Eng. Fundaments. McGraw-Hill.
9. Schugerl. 1987. Bioreaction engineering, J/W.
10. Stanbury and Whitaker. Principles of fermentation technology

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain detail knowledge of single cell protein production and its benefits, Microbial enhance oil recovery, bioleaching of copper, gold, silver.
CO2	Students will learn about microbial processes in agriculture for biopesticides, insecticides, Agitation and Aeration process of fermentation.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	**Program Outcomes**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**2**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**2**	**1**
CO2	**3**	**3**	**2**	**-**	**3**	**2**	**-**	**3**	**2**	**2**	**1**

BMIC601USE: INSTRUMENTATION AND BIOTECHNIQUES

Objective:

- This skill based course will teach the students the various instrumentations that are used in the analytical laboratories.
- This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules.

CREDITS: 02

Unit	Content	Credit	Weightage
I	Chromatography and Electrophoresis 1.1 Chromatography: Principles and application of Paper chromatography, Thin layer chromatography, column packing and filtration collection. 1.2 Gel filtration chromatography ,ion exchange chromatography and affinity chromatography GLC, HPLC. 1.3Electrophoresis: Principle and application of native Polyacrylamide gel electrophoresis,SDS-PAGE,2Dgelelectrophoresis,Isoelectricfocusing,Agarosegelelectrophoresis.	1	50%
II	2.1Spectrophotometryandcentrifugation Spectrophotometry: Principle and use to study of adsorption spectra of biomolecules 2.2 Analysis of biomolecules using UV and visiblerange, Colorimetry and turbidometry. 2.3 Centrifugation: Preparative and analytical centrifugation, fixed angle and swinging bucket rotors, RC Fand sedimentation coefficient Differential centrifugation, density gradient Centrifugation and ultracentrifugation.	1	50%

Reference Books:

1. Wilson, K. and Walker, J., (2010). Principles and Techniques of Biochemistry andMolecular Biology, 7th edition, Cambrige University Press (Low price edition), NewYork.
2. NelsonDLandcoxMM(2008)Lehningerprinciplesofbiochemistry
3. KarpG.(2010)Celland molecularbiology:conceptandexperiments
4. CooperG.MandHausman R.E(2009)Thecell: Amolecularapproach.
NigamAandAyyagariA.2007.LabManualinbiochemistry,immunologyandBiotechnology

Course Outcomes: At the end of the course, students shall be able to

CO1	Development of skills related to handling of instruments.
CO2	Enabling the students to design & standardize various analyses, processes and separation techniques.
CO3	At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**
CO2	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**-**	**2**	**2**	-	**2**	**2**	-	**-**	**-**

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**2**	**2**
CO2	**3**	**2**	**2**	-	**2**	**2**	-	**2**	**2**	-	-	-	**2**	**1**
CO3	**3**	**2**	**2**	-	**2**	**2**	-	**2**	**2**	-	-	-	**2**	**1**

BMIC601UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 03

LIST OF EXPERIMENTS

1. Demonstration of Southern blotting.
2. Demonstration of Northern blotting.
3. Cloning of DNA insert and Blue white screening of recombinants.
4. Demonstration of RFLP.
5. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
6. Isolation, cultivation, identification and study of antibiotic sensitivity (Antibiogram) of Gram negative bacteria.
7. Study of skin micro flora.
8. Urine examination: Physical, chemical, microscopic.
9. Identification of unknown medically important bacteria from mixed population using identification keys:
    1. Escherichia coli,
    2. Enterobacter aerogenes,
    3. Proteus vulgaris,
    4. *Salmonella* group : *S. typhi, S. paratyphi A, S. paratyphi B,*
    5. Shigella dysenteriae,
    6. *Pseudomonas aeruginosa*.
10. Isolation and enumeration of bacteriophage.

BMIC602UPRA: MICROBIOLOGY PRACTICALS

CREDITS: 03

LIST OF EXPERIMENTS

1. Primary screening of (a) Amylase, (b) Organic acid producers. (c) Antibiotic producers, i) crowded plate method, ii) Wilkin's method,
2. Bioassay of Penicillin using Bacillus subtilis.
3. Determination of Oxygen Transfer Rate (OTR) under static, sparing and shaking condition by sodium sulphite method.
4. Sterility testing of Pharmaceutical products
5. Immobilization of cells/enzyme
6. Fermentative production of Amylase and determination of Amylase activity.
7. Typical fermentation of alcohol.
8. Typical fermentation of gluconic acid.
9. Bacterial growth curve.
10. Calculation of thermal death point (TDP) of a microbial sample

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