Tumkur University

Listing of Courses from V to VI Semesters for Undergraduate Program in MICROBIOLOGY

Sem. No.	Course Category	Course Code	Course Title	Credits Assigned	Instructional hours per week		Duration of Exam (Hrs.)	Exam/ Evaluation Pattern (Marks)		
					Theory	Practical		IA	Exam	Total
V	DSC	MBDSC-5	**Microbial Genetics (Theory)**	4	4		2	40	60	100
		MBDSC-5P	**Microbial Genetics (Practical's)**	2		4	3	25	25	50
		MBDSC-6	**Food Microbiology (Theory)**	4	4		2	40	60	100
		MBDSC-6P	**Food Microbiology (Practical's)**	2		4	3	25	25	50
	SEC	MBSEC-4	**Microbial and Biochemical Techniques**	3	2	1	2	50	50	100
VI	DSC	MBDSC-7	**Medical Microbiology and Immunology (Theory)**	4	4		2	40	60	100
		MBDSC-7P	**Medical Microbiology and Immunology (Practicals)**	2		4	3	25	25	50
		MBDSC-8	**Industrial Microbiology and Biotechnology (Theory)**	4	4		2	40	60	100
		MBDSC-8P	**Industrial Microbiology and Biotechnology (Practical's)**	2		4	3	25	25	50
	SEC	MBSEC-5	**Bioethics, Biosafety and IPR**	2	2		2	25	25	50
	Internship	MBDSC-9	Internship	2	3-4 weeks (Report & Viva)			25	25	50

15/9/2023

CHAIR MAN
BOS IN Microbiology
TUMKUR UNIVERSITY
TUMKUR-572103.

5th Semester Model Syllabus for B.Sc. in MICROBIOLOGY

Program Name	B.Sc. in MICROBIOLOGY	Semester	V
Course Title	MICROBIAL GENETICS (Theory)		
Course Code:	MBDSC-5	No. of Credits	04
Contact hours	60 Hours (4 Hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s) :

Course Outcomes (COs) : After the successful completion of the course, the student will be able to:

CO1. Understand the fundamental molecular principles of genetics

CO2. Understand structure of DNA, replication, transcription, translation, regulation of gene expression.

CO3 Knowledge on the basis of genetic mapping in bacteria, linkage analysis in fungi.

Contents	
Unit 1: Mendel's principles of inheritance: Mendel's experimental approach to prove genetic principles. Principles of dominance and Segregation; phenotype, genotype, traits controlled by genes, existence of alleles (dominant and recessive), monohybrid (single character) cross, F1 and F2 generation, heterozygous, homozygous, test cross to test genotype of F1 plants. Principle of independent assortment; Dihybrid (two characters) cross, pattern of assortment of alleles. Chromosomal basis of inheritance; chromosome number, haploid (n), diploid (2n). **DNA as genetic material**; Griffith experiment of Transformation, Experimental evidence to show DNA as the genetic material, involvement of DNA in bacterial transformation by Avery, MacLeod and McCarty, Hershey and Chase experiment to prove DNA carries the genetic information in bacteriophage. RNA as genetic material in viruses.	15 Hrs
Unit 2: Molecular Biology-1 **DNA structure:** Chemistry and structure of DNA, nucleoside, nucleotide, organization of DNA in cells, Watson and Crick model of DNA, DNA denaturation and renaturation. **DNA Replication:** Bacterial Cell cycle. Experimental proof for semi-conservative replication. Replicon. *OriC*. Direction of replication. Stages of replication, Role of DNA polymerases and other enzymes in replication. Theta-replication, rolling-circle model, linear DNA replication. **Transcription:** Gene structure, Stages of transcription – initiation, elongation, termination, prokaryotic and eukaryotic RNA polymerases, -. Promoters, Transcription factors, basal apparatus, RNA splicing and Processing, 5'-capping, mRNA splicing, spliceosome, alternative splicing, polyadenylation, RNA editing.	15 Hrs

Unit 3: Molecular Biology-2: **Translation:** Genetic code, rules governing the genetic code. tRNA structure, ribosome structure. Stages of translation –initiation, elongation and termination. Regulation of translation. Post translational modifications of proteins. **Regulation of gene Expression:** Gene regulation in bacteria. Operon concept, *lac* operon, *trp* operon, Control of gene expression in eukaryotes - Regulation through modification of gene structure- histone modifications, chromatin remodeling, DNA methylation. transcriptional activators, RNA interference. **Mutations:** Mutations and their chemical basis, types of mutations – Spontaneous and induced mutations, physical and chemical agents of mutagenesis, the expression of mutations, mutant detection and selection. **DNA repair:** DNA repair mechanisms, excision repair, SOS repair, post-replication repair, recombination repair.	15 Hrs
Unit 4: **Genetics of Viruses:** Structure and life cycle of Bacteriophage T4 and Lambda, lytic and lysogenic cycle of bacteriophage. Recombination and genome mapping in viruses. **Genetics of Bacteria**: Structure and life cycle of bacteria, General principles of bacterial recombination, bacterial plasmids, fertility factors, resistance factors, col plasmids, other types of plasmids, transposable elements. Trasformation: Competence, compatibility, transformants. Conjugation: F^+ x F^- conjugation, Hfr conjugation, $F^'$ conjugation, Genemapping in bacteria by conjugation. Transduction: Generalized and specialized transduction, mapping the genome. **Genetics of Fungi**: life cycle of Yeast and *Neurospora*, heterothallism, parasexuality, Terad analysis, two point and three point test cross, detecting linkage and mapping genes in yeast and *Neurospora*, recombination in fungi.	15 Hrs

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
Understand the fundamental molecular principles of genetics		√		√			√					
Understand structure of DNA, replication, transcription, translation, regulation of gene expression.		√					√				√	
Knowledge on the basis of genetic mapping in bacteria, linkage analysis in fungi.		√					√					√

Pedagogy: Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10
Seminar	10
Debate/Quiz/Assignment	10
Class test	10
Total	**40 Marks**
Formative Assessment as per guidelines are compulsory	

Course Title	MICROBIAL GENETICS (Practical)	Practical Credits	02
Course Code	MBDSC-5P	Contact Hours	4 Hours/ week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Practical Content

	Practicals - List of experiments
1.	Micropipeting: Volume Accuracy
2.	Study of semi-conservative replication of DNA through micrographs / schematic representations
3	Mendelian inheritance in pea plant – monohybrid, dihybrid ratio through charts, Genetic problems
4	Isolation of bacteria/fungal DNA
5	Isolation of phages from sewage
6	Bacterial survival against UV-radiation
7	Isolation of antibiotic resistant mutant by gradient plate method
8	Isolation and characterization of petite mutant in yeast
9	Isolation of RNA from yeast.
10	Replica plating technique
11	Estimation of DNA
12	Estimation of RNA
13	Estimation of protein
14	Agarose gel electrophoresis
15	Bacterial conjugation, transformation, transduction charts

MICROBIAL GENETICS

Course Objectives:

The objectives of this course are to introduce students to:

- Basics of genetics and classical genetics covering prokaryotic and eukaryotic domains.
- Classical concepts of Mendelian genetics, recombination in bacteria and fungi.

Student Learning Outcomes:

At the end of the course, students should be able to:

- Describe fundamental molecular principles of genetics;
- Understand relationship between phenotype and genotype in human genetic traits;
- Evaluate the basics of genetic mapping in bacteria, linkage analysis in fungi.

Pedagogy: Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Class Records	05
Test	10
Attendance	05
Performance	05
Total	**25 Marks**
Formative Assessment as per guidelines are compulsory	

REFERENCES :

1. Microbial Genetics by Maloy ET. Al. 1994. Jones and Bartlett Publishers.
2. Molecular Genetics of Bacteria by J. W. Dale. 1994. John Wiley and Sons.
3. Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.
4. Moleculat Biology of the Gene 4th Edition by J.D. Watson, N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. Inc. California.
5. Gene VII by Lewin Oxford University Press. 2000.
6. Bacterial and Bacteriophage Genetics. 4th Editions by Birge.
7. Microbial Genetics by Frefielder. 4th Edition.
8. Organization of Prokayotic Genome. 1999 by Robert L.Charlebois, ASM Publications.
10. Molecular Genetics of Bacteria, 1997 by Larry, Snyder and Wendy, Champness, ASM

Program Name	BSc in Microbiology	Semester	V
Course Title	FOOD MICROBIOLOGY (Theory)		
Course Code:	MBDSC- 6T	No. of Credits	04
Contact hours	60 Hours (4 Hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. To understand the association of microbes in food and the quality testing of food
CO2. To understand the preservation and food safety protocols
CO3. To understand the methods of spoilage of food and the diseases associated with it
CO4. To learn the properties of milk and the types of preservation of milk.
CO5. To learn the types of fermented food and dairy products and its significance

CONTENTS	45 Hrs
Unit 1-Microbes and food : Food as a substrate for microorganisms- Intrinsic and extrinsic parameters affecting the growth of microbes. Microorganisms in food and their sources(molds,yeast and bacteria) **Food borne infections** and intoxication *Staphylococcus, Clostridium. Salmonella, Bacillus, Brucella, Listeria.* Mycotoxins, **Fermented Food :** Fermented vegetable-sauerkraut, pickles. Meat- sausage. Beverages-kombucha. Sourdough. Microbes as food- SCP, SCO. Neutrceuticals and Synbiotics	15 hrs
Unit 2-Spoilage of Food, Preservation and Food safety- **Spoilage :** Principles of food spoilage.Sources of food contamination, Types of spoilage. Spoilage of meat and poultry, Fish and sea foods. Spoilage cereals, fruits and vegetables.Spoilage of canned food. **Preservation:** Principles of food Preservation. Methods of preservation-Physical(temperature, drying, irradiation),chemical (Class I and Class II). Bio preservation. Canning. Food safety, Food Packaging-Types of packaging materials, properties and benefits. Quality testing of food- Rapid microbiological methods, Examination of faecal contaminants.	15hrs
Unit-3: a) Food Biotechnology: Single cell protein – *Spirulina, Fusarium, Saccharomyces*; fermented foods, mushroom technology; fungal foods; microbial production of flavours, natural food colourants from bacteria, fungi and algae, enzymes for food processing (protease, lipase, invertase,) sweeteners, food waste management, **b) Food and sanitation:** **Food sanitation and control-** Good Hygiene practices, GLP, GMP(Waste treatment disposal methods), HACCP, Food control agencies and their regulation –FSSAI, FDA, FAO	15hrs

Unit 5-Dairy Microbiology: History. Properties of milk. Types of milk- dried, liquid, condensed. **Microorganisms in milk.** Starter culture and its types-(single, mixed) Sources of contamination of milk. Microbiological analysis of milk- Rapid platform tests(organoleptic, alcohol, COB, alcohol test, Phosphatase test, DMC, sedimentation test.). Reductase tests. SPC. Preservation of milk- Pasteurization. Dehydration, sterilization. . Packing of milk and dairy products. **Fermentation in milk**: Lactic acid, gassy fermentation, souring **Dairy products:** Cheese- Types and production (Cheddar), Tofu, Yoghurt, Acidophilus milk. Prebiotics, Probiotics.	15 hrs

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
To understand the association of microbes in food and the quality testing of food		√						√			√	√			
To understand the preservation and food safety protocols		√					√			√					
To understand the methods of spoilage of food and the diseases associated with it		√		√											
To learn the properties of milk and the types of preservation of milk.	√	√													
To learn the types of fermented food and dairy products and its significance				√	√			√							

Pedagogy: Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10
Seminar	10
Debate/Quiz/Assignment	10
Class test	10
Total	**40 Marks**
Formative Assessment as per guidelines are compulsory	

Course Title	FOOD MICROBIOLOGY (Practical)		Practical Credits	02
Course Code	MBDSC-6P		Contact Hours	4HRS/WEEK
Formative Assessment	25 Marks	Summative Assessment		25 Marks

Practical Content

1. Isolation of bacteria and fungi from infected fruits and vegetables
2. Isolation of bacteria and fungi from fermented food and stored/ preserved food.
3. Reductase tests-MBRT/Resazurin
4. Estimation of Titrable acidity inmilk.
5. Fat estimation – Gerber's method
6. Bacterial examination by SPC, DMC
7. Estimation of lactose in milk
8. Production of yoghurt
9. Study of food borne pathogens- *Staphylococcus, Salmonella, Aspergillus, Clostridium*
10. Detection of Aflatoxin by TLC
11. Significant microbes in Food and Dairy - *Lactobacillus, Streptococcus, Penicillium, Rhizopus*

Pedagogy: Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Class Records	05
Test	10
Attendance	05
Performance	05
Total	**25 Marks**

Formative Assessment as per guidelines are compulsory

References

1	Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of Chemistry, Cambridge.
2	James. M. Jay, 1992, Modern food microbiology 4ed.
3	Frazier W.C. and Westhoff C.D. 2008 Food Microbiology. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
4	Doyle M. P. and Beuchat L. R. (2007). Food Microbiology- Fundamentals. Frontiers, ASM Press.
5	Garbutt J. (1997). Essentials of Food Microbiology, Armold- International Students edition, London. 8. Marriott N. G. and Gravani R. B. (2006).
6	Principles of Food Sanitation, Food Science text Series, Springer International, New York, USA.
7	ThomasJ., Matthews,Karl; Kniel, Kalmia E (2017), Food Microbiology: An Introduction, American Society for (ASM).
8	Deak T. and Beuchat L. R. (1996). Hand Book of Food Spoilage Yeasts, CRC Press, New York.

6th Semester Model Syllabus for B.Sc. in MICROBIOLOGY

Program Name	B.Sc. in Microbiology		Semester	VI
Course Title	MEDICAL MICROBIOLOGY AND IMMUNOLOGY (Theory)			
Course Code:	MBDSC-7		No. of Credits	4
Contact hours	60 Hours (4 hours per week)		Duration of SEA/Exam	2 hours
Formative Assessment Marks	40		Summative Assessment Marks	60

Course Pre-requisite(s): Common to the Course Programme at Entry Level
Course Outcomes (COs): After the successful completion of the course, the student will be able to: CO1: To gain a preliminary understanding about various immune mechanisms. CO2: To familiarize with Immunological techniques and serodiagnosis of infectious diseases CO3: To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process. CO4: To understand pathogenic bacterial infections, symptoms, diagnosis and To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process treatment process

UNIT-I: Human microbiota and Medical Bacteriology Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS. Sample collection, transport and diagnosis. **Medical Bacteriology** Details of Symptoms, mode of transmission, prophylaxis and control Rrespiratory diseases: *Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis* Gastrointestinal Diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae,* Others: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani*	15 hrs.
UNIT-II Medical Virology, parasitology and Mycology Details of Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Corona, Influenza, swine flu, Ebola, Chikungunya,Japanese Encephalitis Protozoan diseases: Malaria, Kala-azar, Entamoeba Fungal infections- Cutaneous mycoses: Tinea, pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis Antimicrobial therapy: Antimicrobial agents: General characteristics and mode of action Antibacterial agents: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine . Antibiotic resistance, MDR, XDR, MRSA, NDM-1	15 Hrs

UNIT-III: Immunosystem Edward Jenner, Louis Pasteur, Immunity; Natural (active and passive) and artificial (active and passive) with example, Innate and acquired, Humoral and cell mediated. Early theories to explain the formation and specificity of antibody; Selective, instructional and clonal selection. Cells and organs of immune system: Hematopoiesis, cytokines, properties and functions of B and T Lymphocytes, Natural killer (NK) cells, Granulocytes (Neutrophils, Eosinophils and Basophils), Monocytes and macrophages, Dendritic cells and Mast cells. Primary lymphoid organs; Bone marrow and Thymus. Secondary lymphoid organs; Spleen and Lymph nodes.	15 Hrs
UNIT-IV: Antigen and antibody Antigen: Immunogenicity and antigenicity, epitopes, haptens. Properties of antigen contribute to immunogenicity; Chemical nature (proteins, carbohydrates, lipids and nucleic acids), degree of foreignness, molecular weight, chemical composition and complexity, degradability. Adjuvants (alum, Freund's incomplete and complete) and their importance. epitopes. Antibody: Basic structure of antibody, light and heavy chain, variable and constant region, hinge region. Structure and functions of different types of antibodies (IgM, IgG, IgA, IgE, and IgD). Antibody mediated effector functions; opsonization, complement activation and antibody dependent cell mediated cytotoxicity (ADCC). Antigenic determinants on immunoglobulins: Isotype, allotype and idiotype. Polyclonal Monoclonal antibody production . Complement system: Functions of complement components, Complement activation, type of complement activation pathways, membrane attack complex (MAC), complement fixation, Hypersensitive reactions: Classification, Type I, Type II, Type III and Type IV, Antigen-antibody interactions: Definition of affinity and avidity.Agglutination, Immunoprecipitation; Radial diffusion (Mancini) and double diffusion (Ouchterlony), Enzyme linked immune-sorbent assay (ELISA): Direct, indirect and sandwich ELISA. Radioimmunoassay (RIA). Immunofluorescence.	15 Hrs

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	1	12	13	14	15
To gain a preliminary understanding about various immune mechanisms.	√														
To familiarize with Immunological techniques and serodiagnosis of infectious diseases		√	√							√					
To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process	√			√						√					
To understand pathogenic bacterial infections, symptoms, diagnosis and To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process treatment process	√				√	√				√					

Pedagogy : Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10 Marks
Class Test	10 Marks
Debate/Quiz/Assignment	10 Marks
Seminar	10 Marks
Total	**40 Marks**
Formative Assessment as per guidelines are compulsory	

Course Title	MEDICAL MICROBIOLOGY AND IMMUNOLOGY (Practical)	Practical Credits	2
Course Code	MBDSC-7P	Contact Hours	4Hours/week
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

1	Identify pathogenic bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcu Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2	Study of composition and use of important differential media for identification of pathogenicbacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3	Study of bacterial flora of skin by swab method
4	Acid-fast staining.
5	Dental caries susceptibility test
6	Antibacterial sensitivity by Kirby-Bauer method
7	Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, Candidiasis, dermatomycoses, ring worms
8	Study of various stages of Malarial parasite in RBCs using permanent mounts.
9	Identification of human blood groups.
10	Perform Total WBC Count of the given blood sample.
11	Perform Differential WBC Count of the given blood sample.
12	Separate serum from the blood sample (demonstration).
13	Perform immunodiffusion by Ouchterlony method.
14	Perform DOT ELISA.
15	Immunoelectrophoresis (Demonstration)

Pedagogy: Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Attendance	05 Marks
Records	05 Marks
Performance	05 Marks
Test	10 Marks
Total	25 Marks
Formative Assessment as per guidelines are compulsory	

Program Name	B.Sc. in Microbiology	Semester	VI
Course Title	INDUSTRIAL MICROBIOLOGY AND BIOTECHNOLOGY		
Paper code	MBDSC-8T	No. of Credits	3
Contact hours	60 Hours (4 Hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s): Common to the Course Programme at Entry Level

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Learn the overview of scope and importance of industrially important microbes

CO2.Acquaint with different types of fermentation processes and equipments

CO3. Evaluate the factors influencing the enhancement of cell and product formation during fermentation

CO4. Acquire the knowledge of the production of value-added products

CO5. Acquire the knowledge of purification of value-added products

Contents	60 Hrs
Unit-I: **Introduction**: Scope and concepts; Criteria for selection of industrially important microbes; Preservation of industrially important microbes. Types of fermentation process: Submerged fermentation, Solid state fermentation, batch fermentation, continuous fermentation, **Fermentor**: Basic features; design and components of a bioreactor; Sterilization of fermentor, Control of air, temperature, pH, foaming and feed; Aseptic inoculation and sampling methods; Scale up of fermentation process-Merits and demerits. Fermentation media: Strategies for media formulation; Natural and synthetic media; Role of buffers, precursors, inhibitors, inducers and micronutrients.	15 Hrs
Unit-II: General production strategies of microbial products and Downstream processing: Antibiotic, Enzymes, anti-cholesterol compound, anti-cancerous compound, hormones. Objectives and significance of downstream processing: Overview of steps in extraction and purification of product; Filtration and centrifugation; cell disruption- Physical, chemical and biological methods; Product extraction; product purification, recovery and product testing. Enzyme immobilization Methods of immobilization, advantages and applications of immobilization,	15 Hrs
Unit-III: Genetic Engineering: Restriction modification systems- Types, Mode of action, nomenclature, applications of restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: DNA polymerases, methylases, Terminal deoxynucleotidyl transferase, kinases and phosphatases and DNA ligases. **Cloning Vectors**: Definition and Properties. Characteristics of cloning vectors. Plasmid vectors: pBR and pUC series. Bacteriophage lambda, cosmids, BACs, YACs. Use of linkers and adaptors.	15 Hrs

Expression vectors: Baculovirus based vectors. DNA transfer methods: Microinjection, Biolistic, Electroporation, Calcium and Liposome mediated DNA transfer. Identification and selection of recombinants: DNA hybridization, DNAsequencing- Sanger's method. PCR techniques and applications. Genome library	
Unit-4: Biotechnology: Microbial synthesis of commercial products- protein pharmaceuticals Insulin and Interferons; antibiotics; bioplastics (PHB, PHA), microbial enzymes, microbial metabolites – organs acids, amino acids, Plant Biotechnology: Transgenic plants: principle, production method and development of pest and disease resistant plnats; tolerance to abiotic stress; genetic manipulation of flower pigmentation; nutritional improvement: modification of plant products, edible vaccines, anti-sense RNA technology. Animal Biotechnology : Cloning strategies, somatic nuclear transfer; Methods and applications of transgenic animals; mammalian cell culture; brief account of gene therapy, ethical aspects of cloning and transplantations.	15hrs.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Learn the overview of scope and importance of industrially important microbes	√														
Acquaint with different types of fermentation processes and equipments												√			
Evaluate the factors influencing the enhancement of cell and product formation during fermentation								√							
Acquire the knowledge of the production of value-added products											√				
Acquire the knowledge of purification of value-added products											√				

Pedagogy: Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10 Marks
Class Test	10 Marks
Debate/Quiz/Assignment	10 Marks
Seminar	10 Marks

Total	40 Marks
Formative Assessment as per guidelines are compulsory	

Course Title	INDUSTRIAL MICROBIOLOGY AND BIOTECHNOLOGY (Practical)	Practical Credits	2
Course Code	MBDSC-8P	Contact Hours	4 Hours/ Week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

PRACTICAL CONTENT

1. Demonstration of a basic fermentor
2. Preparation of natural medium used in a industry
3. Preparation of synthetic medium used in a industry
4. Production of amylase/protease/cellulase/pectinase/invertase by solid substrate fermentation (with Atleast 2 substrates)
5. Production of enzyme (amylase/protease/cellulase/invertase by submerged fermentation
6. Preservation of microbes with glycerol/soil.
7. Resolution and visualization of DNA by agarose gel electrophoresis.
8. Induction of mutations in bacteria by UV light.
9. Preparation of competent cells and demonstration of bacterial transformation.
10. Digestion of DNA with restriction enzymes.
11. Preparation of master and replica plates.
12. Production and estimation of any one secondary metabolite
13. Cell immobilization.
14. Estimation of microbial aminoacids.
15. Study of cloning techniques through charts, figures

Pedagogy: Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Attendance	05 Marks
Records	05 Marks
Performance	05 Marks
Test	10 Marks
Total	**25 Marks**
Formative Assessment as per guidelines are compulsory	

References	
1	Arindam Kuilaand Vinay Sharma (2018) Principles and Applications of Fermentation Technology, Wiley.
2	Casida L E.J.R. (2016) Industrial Microbiology, 2nd edition, New Age International Publisher.
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10	Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. BlackwellPublishing, Oxford, U.K.
11	Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
12	Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold SpringHarbor Laboratory Press
13	Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring HarbourLaboratory press.
14	Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill HigherEducation.

Program Name	**B.Sc. Microbiology**	Semester	**5th Semester**
Course Title		**Microbial and Biochemical Techniques**	
Course No.	**MBSEC-4**	No. of Theory +Practical Credits	**2+1 (Theory+Practicals)**
Contact hours	**45 hrs**	Duration of ESA/Exam	**02 hrs**
Formative Assessment (T+P)	**50**	Summative Assessment Marks (T+P)	**50**

Unit 1: Microbiological Skills **15 hours**

Microbiological Skills Types of culture media with examples. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media. Cultivation of anaerobic bacteria and accessing non-culturable bacteria. Cultivation of fungi, actinomycetes, yeasts, algae. Cultivation of anaerobes. Isolation of microorganisms and pure culture techniques. Preservation of microorganisms. Characterization of bacteria: Colony characters, biochemical tests.

Unit II: Biochemical Techniques **15 hours**

Microscopy: Different types of Microscopes: Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluoresence microscopy, Confocal microscopy, Scanning and Transmission Electron Microscopy, Scanning Probe microscopy. Centrifugation: Principles of Centrifugation and Ultracentrifugation techniques and its applications.

Unit III: Chromatography **15 hours**

Principle and techniques with applications (Partition, adsorption, ion exchange, exclusion and affinity chromatography). Electrophoretic technique (agarose and polyacrylamide gel) its components, working and applications. Spectrophotoscopy and Radiobiology: Principle, mechanism and application of instruments used in Spectrophotometric techniques (UV and visible).Radiobiological techniques – characters of radioisotopes, autoradiography, Radioisotope dilution technique and pulse chase experiments. Basic principles & Law of absorption and radiation and its application.

Program Name	**B.Sc. Microbiology**	Semester	**6th Semester**
Course Title		**Bioethics, Biosafety and IPR**	
Course No.	**MBSEC-5**	No. of Theory +Practical Credits	**2 (Theory+Practicals)**
Contact hours	**30 hrs**	Duration of ESA/Exam	**02 hrs**
Formative Assessment (T+P)	**25**	Summative Assessment Marks (T+P)	**25**

Unit-1: Introduction to biosafety and bioethics **15 hours**

Biosafety: Introduction, History, and significance of biosafety in microbiology, Principles of biosafety, Biosafety levels (BSL1-BSL 4), classification of hazardous microorganisms, Standard Microbiological Practices, Biosafety cabinets, and types Biosafety equipment's, Biosafety guidelines and regulations, Occupational hazards, Risk analysis, GMO: Concerns and challenges

Bioethics: Introduction, history and scope of bioethics, moral problems concerned with genome research, Manipulation of microorganisms and genetic diagnosis, Ethical issues of gene therapy, Social and ethical issues in GMOS, bioweapons, Ethical issues in use of animals in research and food production.

Unit – II: IPR

Intellectual property, Introduction to intellectual property rights, different forms of IPR and importance. Patents-types of patents, Patentable and Nonpatentable Inventions. Salient features of Indian patent law. Patent filing and patent Grant process, Patent infringement- Direct and indirect Copyrights: : Introduction, copy right subject matter, copyright protection Trade mark: meanings a, types, and importance Trade secrets, Geographic indication, Industrial designs and rights.

13/9/2023

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