BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course)

Syllabus for B.Sc. Microbiology
(V & VI Semester)

2023-24 onwards

Bangalore University

Program Name	**BSc in MICROBIOLOGY**	Semester	**V**
Course Title	**MOLECULAR BIOLOGY (Theory)**		
Course Code:	**MBL 105-I; DSC T5-I**	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours per week)**	Duration of SEA/Exam	**2½ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course objective(s):

1. To learn the concepts of replication, transcription, translation, regulation of gene expression in Prokaryotes and Eukaryotes.
2. To learn about synthesis of protein
3. To provide knowledge about constitutive, inducible and repressible genes

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

CO1. Understand concepts involved in replication, transcription, translation, regulation of gene expression in Prokaryotes and Eukaryotes.

CO2. Differentiate the process of replication, transcription, translation, regulation of gene expression in Prokaryotes and Eukaryotes.

CO3. Understand the genetic switch in Viruses (bacteriophages).

CO4. Compare and contrast housekeeping, constitutive, inducible and repressible genes

CO5. Outline regulatory mechanisms in Bacteria to control cellular processes

Contents	
UNIT 1: DNA Replication and Prokaryotic transcription **Introduction:** Central dogma of molecular biology, Structure and types of DNA and RNA, Gene, Genetic code. **DNA Replication:** Bacterial Cell cycle. Types of DNA replication- Rolling. Circle and theta model. Modes of DNA replication- Conservative, Semi- Conservative and dispersive. Steps in Initiation of replication, Enzymes in DNA replication, Replicon, OriC. Replication fork, replisome, Okazaki fragments, Termination of replication. **Prokaryotic Transcription:** Transcription bubble, Stages of transcription, Bacterial RNA polymerase - structure and mechanism, Recognition of promoters and DNA melting, Initiation, Elongation, Termination, Abortive, Transcription inhibitors.	**15 Hrs**
UNIT 2: Eukaryotic Transcription **RNA synthesis:** RNA polymerases in Eukaryotes- Types and Mechanism of RNA polymerase. Promoters, Transcription factors, basal apparatus, Enhancers, silencers. Initiation, elongation, termination. Transcription inhibitors. **RNA splicing and Processing**: mRNA capping, pre-mRNA splicing, snRNPs, spliceosome, types of splicing, polyadenylation, RNA maturation, Catalytic RNAs - auto splicing, ribozymes, RNA editing.	**15 Hrs**

UNIT 3: Translation **Introduction:** structure tRNA, rRNA and ribosome, charging of tRNA, differences between initiator tRNA and elongator tRNA. Steps in translation- Initiation, elongation, and termination. Role of initiation factors in bacterial translation, Formation of initiation complex, polypeptide, peptide bond formation, peptidyl transferase activity, translocation, termination. Differences between prokaryotic and eukaryotic translation. Regulation of translation. Post translational modifications of proteins. Protein maturation and secretion. Protein translocation and inhibitors.	**15 Hrs**
UNIT 4: Regulation of gene expression in Prokaryotes and Acellular Microbes Regulatory mechanisms in bacteria- Positive and negative regulation. Operon concept, polycistronic mRNA. *lac* operon, trp operon, Catabolic repression and attenuation. Regulation of lytic & lysogenic life cycle in bacteriophage (λ page). Control of lytic cycle by regulatory proteins. **Regulation of gene expression in eukaryotes** Regulation through modification of gene structure- DNase I, histone, DNA methylation. Regulation through transcriptional activators, co-activators and repressors, enhancers and insulators.	**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 concepts involved in replication, transcription, translation, regulation of gene expression in bacteria and eukaryotes		√	√		√							√
Differentiate the process of replication, transcription, translation, regulation of gene expression in bacteria and eukaryotes		√	√		√							√
Understand the genetic switch in bacteriophages		√	√		√							√
Compare and contrast housekeeping, constitutive, inducible and repressible genes		√	√		√							√
Outline regulatorymechanisms in bacteria to control cellular processes		√	√		√							√

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	

Bangalore University

Course Title	**MOLECULAR BIOLOGY (Practical)**	Practical Credits	**02**
Course Code	**MBL 105-I; DSC P5-I**	Contact Hours	**4 Hours/ week**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

1. Study of semi-conservative replication of DNA through micrographs / schematic representations
2. Extraction of crude DNA from bacteria and yeast by phenol-chloroform method.
3. Determination of purity and quantity of DNA
4. Determination of DNA melting point and GC content
5. Extraction and visualization of plasmids from bacterial cultures
6. Extraction and visualization of genomic DNA from bacterial cultures
7. Measurement of β-galactosidase activity in stimulated and control cells of *E.coli*
8. β-galactosidase activity assay in Yeast
9. DNA elucidation from agarose gel
10. RNA extraction from yeast and visualization
11. Analysis of RNA quality and integrity
12. Determining nucleotide composition of RNA
13. Restriction enzyme digestion of DNA molecule - DNA fingerprinting
14. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE)

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	*Karp's Cell and Molecular Biology* by Gerald Karp, Janet Iwasa, Wallace Marshall. Ninth Edition. 2020
2	Lewin's Genes XII. Jocelyn E Krebs, Elliott S Goldstein, Stephen T Kilpatrick. Jones and Bartlett Learning.2017
3	James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. Molecular Biology of the Gene, 7th edition. 2017
4	Freifelder's Essentials of MOLECULAR BIOLOGY. George M Malacinski, 4th ed. 2015
5	Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India
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7	Alberts Bruce , Johnson A , Lewis J , Raff M , Roberts K, Walter P (2014) Molecular Biology of the Cell. 5th Edition, Taylor and Francis. New York, USA.
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9	Allison A. Elizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken,New Jersey
10	Aranda PS, LaJoie DM, Jorcyk C L (2012). Bleach Gel: A Simple Agarose Gel for Analyzing RNA Quality. Electrophoresis. 33(2): 366–369. Doi: 10.1002/elps .201100335.
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12	Chomczynski P, Sacchi N (2006). "The single-step method of RNA isolation by acid guanidinium thiocyanate-phenol-chloroform extraction: twenty-something years on". Nat Protoc. 1 (2): 581–5. doi:10.1038/nprot.2006.83.
13	Elkins K M (2013). DNA Extraction Forensic DNA Biology.
14	Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, Kevin Struhl (2003). Current Protocols in Molecular Biology. John Wiley & Sons, New York, United States.
15	Johnson M (2019). RNA extraction, Synatom Research, Princeton, New Jersey, United States. DOI//dx.doi.org/10.13070/mm.en.2.201.
16	Lewis M. Agarose gel electrophoresis (basic method). Department of Pathology, University of Liverpool. http://diyhpl.us/~bryan/irc/protocol-online/protocolcache/agarogel.html
17	Randall DR. (2009). Molecular Biology Laboratory manual.
18	Sambrook JF, Russell DW (2001). Molecular Cloning: a Laboratory Manual. 3rd edition. Cold Spring Harbor, N.Y. Cold Spring Harbor Laboratory Press
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20	Surzycki S (2000). Basic techniques in molecular biology. Springer.
21	Yılmaz M, Ozic C, Gok İ (2012). Principles of Nucleic Acid Separation by Agarose Gel Electrophoresis. Gel Electrophoresis - Principles and Basics, Dr. Magdeldin S (Ed.), ISBN: 978-953-51-0458-2, InTech. http://www.intechopen. com/books/gel-electr ophoresis-principles-Andbasics

Bangalore University

Program Name	**BSc in Microbiology**	Semester	**V**
Course Title	**FOOD MICROBIOLOGY (Theory)**		
Course Code:	**MBL 105-II; DSC T5-II**	No. of Credits	**04**
Contact hours	**60 Hours(3 Hours per week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course objective(s):

1. To learn the microbes in food and the quality testing of food.
2. To learn about methods of spoilage of food and the diseases associated with it
3. T o gain knowledge regarding the preservation and food safety protocols

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 foodstuffs Introduction, Food as a substrate for microorganisms- Intrinsic and extrinsic parameters affecting the growth of microbes. Types of microorganisms in food- Moulds, yeasts and bacteria. **Food borne infections and intoxications-** Causative organism, mode of entry, symptoms, Treatment and control of *Staphylococcal food poisoning, Botulism, Salmonellosis, Brucellosis, Listeriosis.* General account of Mycotoxins and Phycotoxins. **Fermented Food:** Fermented vegetable- sauerkraut, pickles. Meat- sausage. Beverages- kombucha. Sourdough. Microbes as food- SCP, SCO. Nutraceuticals and Symbionts.	15 hrs
Unit 2: Food Spoilage and Preservation **Food Spoilage:** Principles of food spoilage, Sources of food contamination, Types of food spoilage. Spoilage of Meat, Poultry, Fish and Sea foods. Spoilage of 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) and Bio preservation. Canning. Food additives. Food Packaging- Types of packaging materials, properties and benefits.	15hrs
Unit 3: Dairy Microbiology **Introduction:** History of white revolution. Properties and nutritional value of milk. Types of milk- dried, liquid, condensed. **Microorganisms in milk:** Normal and contaminant microflora in milk, pathogenic microbes in milk. Starter culture and its types. Sources of contamination of milk. Microbiological analysis of milk- Rapid platform tests (organoleptic, COB, alcohol, Phosphatase, DMC, sedimentation tests) and reductase tests. SPC. Preservation of milk- Pasteurization. Dehydration, sterilization. Packing of milk and dairy products. **Fermentation in milk**: Lactic acid, gassy fermentation, souring, ropiness. **Dairy products:** Cheese- Types and production (Cheddar), Tofu, Yoghurt, Acidophilus milk. Prebiotics, Probiotics.	15 hrs

Unit 4: Food Standards and quality control: **Quality testing of food**- Rapid microbiological methods. Examination of fecal contamination. **Food sanitation and control -** Good Hygiene practices, GLP, GMP (Waste treatment disposal methods), HACCP and Food control agencies and their regulation. Bacterial indicator organisms in food contamination. Food Safety –risk and hazards, Food Safety Laws and Regulations- BIS, FSSAI, Codex Alimentarius.	**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	

Bangalore University

Course Title	**FOOD MICROBIOLOGY (Practical)**	Practical Credits	**02**
Course Code	**MBL 105-II; DSC P5-II**	Contact Hours	**4HRS/WEEK**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

1. Isolation of bacteria and fungi from spoilt fruits and vegetables
2. Isolation of bacteria and fungi from fermented food and stored/ preserved food.
3. Reductase tests-MBRT/Resazurin/phosphatase
4. Estimation of Titrable acidity in milk.
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. Study of significant microbes in Food and Dairy- *Lactobacillus, Streptococcus, Penicillium*, *Rhizopus*
11. Standard analysis of water
12. Study of leavening properties of yeast
13. To study the normal flora of egg and fish
14. Wine preparation
15. Entrepreneurship –To study the necessary measures to be an entrepreneur in food industry

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 CompanyLimited, New Delhi, India.
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7	ThomasJ., Matthews,Karl; Kniel, Kalmia E (2017), Food Microbiology: An Introduction, AmericanSociety for (ASM).
8	Deak T. and Beuchat L. R. (1996). Hand Book of Food Spoilage Yeasts, CRC Press, New York.

Bangalore University

Program Name	**BSc in Microbiology**	Semester	**VI**
Course Title	**IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Theory)**		
Course Code:	**MBL106-I; DSC T6-I**	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 objective(s):

1. To learn various immune mechanisms
2. To learn about pathogenic bacterial infections, symptoms, diagnosis and treatment process.
3. T o gain knowledge regarding the Immunological techniques and serodiagnosis of infectious diseases

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

Contents	60 Hrs
UNIT I: Host and microbe interaction **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 andtheir types, Opportunistic infections, Nosocomial infections. Transmission of infection. **Bacterial diseases:** Symptoms, mode of transmission, prophylaxis and control of Respiratory diseases: *Haemophilus influenzae, Mycobacterium tuberculosis*; Gastrointestinal diseases: *Salmonella typhi*, *Vibrio cholera*; Others: *Bacillus anthracis, Clostridium tetani*.	**15 hrs.**
UNIT II: **Medical Virology, Parasitology and Mycology** Symptoms, mode of transmission, prophylaxis and control of Hepatitis, Rabies, Dengue, AIDS, Corona, Influenza, Chikungunya; Protozoan diseases: Malaria; Fungal infections- Pedis (Athlete's foot), Candidiasis. **Antimicrobial agents:** General characteristics and mode of action of antibacterial agents: Inhibitor of Cell wall, Cell membrane, Nucleic acid and Protein synthesis; Inhibitor of metabolism. Mechanism of action of Amphotericin B, Cephalosporin, Penicillin, Tetracyclin, Griseofulvin Amantadine, Acyclovir, Azidothymidine. Antibiotic resistance microbes.	**15 Hrs**
UNIT-III: Introduction to Immunology Historical perspective of immunology; Immunity; Natural (active and passive) and artificial (active and passive) with example, Innate and acquired, Humoral and cell mediated. 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 Lymphnodes.	**15 Hrs**

UNITIV: Antigen and Antibody reaction	15 Hrs
Antigen: Immunogenicity and antigenicity, Epitopes, B and T cell epitopes, Haptens, Properties and Chemical nature of antigen. **Antibody**: Basic structure of antibody, light and heavy chain, variable and constant region, hinge region, Fab and Fc. Structure and functions of different types of antibodies (IgM, IgG, IgA, IgE, and IgD). Antibody dependent cell mediated cytotoxicity (ADCC). Antigenic determinants on immunoglobulins: Isotype, allotype and idiotype. Monoclonal antibody production by hybridoma technology **Principles and applications of antigen-antibody interactions:** Definition of affinity and avidity. Immunoprecipitation; Radial (Mancini) and double (Ouchterlony) immunodiffusion. Agglutination reactions: Hemagglutination and Bacterial agglutination. Enzyme linked immune-sorbent assay (ELISA). Hypersensitivity reactions: Definition and Classification	

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	

Bangalore University

Course Title	**IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Practical)**	Practical Credits	**2**
Course Code	**MBL 106-I; DSC P6-I**	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, Staphylococcus, Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitratereduction, urease production and catalase tests
2	Study of composition and use of important differential media for identification of pathogenic bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3	Study of bacterial flora of skin by swab method
4	Antibacterial sensitivity test
5	Study of symptoms of the diseases with the help of photographs: Hepatitis, AIDS, Corona, Influenza, Pedis (Athlete's foot), Candidiasis
6	Study of various stages of Malarial parasite in RBCs using permanent mounts.
7	Identification of human blood groups.
8	Perform Total Leukocyte Count of the given blood sample.
9	Perform Differential Leukocyte Count of the given blood sample.
10	Separate serum from the blood sample (demonstration).
11	Perform immunodiffusion by Ouchterlony/ Radial diffusion method.
12	Perform DOT ELISA.
13	Perform immunoelectrophoresis.

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	Ananthanarayan R and Paniker C.K.J (2009) Textbook of Microbiology, 8th Edition, University Press, Publication.
2	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3	Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
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5	Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition
6	Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th editionSaunders Publication, Philadelphia.
7	Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
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Bangalore University

Program Name	**BSc in Microbiology**	Semester	**VI**
Course Title	**MICROBIAL GENETIC ENGINEERING AND INDUSTRIAL MICROBIOLOGY(Theory)**		
Course Code:	**MBL 106-II; DSC T6-II**	No. of Credits	**4**
Contact hours	**60 Hours (3 Hours per week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course objective(s):

1. To learn the concepts and terminology in genetic engineering
2. To learn about principles involved in manipulating genes and DNA
3. T o gain knowledge regarding the importance of industrially important microbes and acquire the knowledge of the production of value-added products

CO1 : To acquire knowledge on the concepts and terminology in genetic engineering
CO2 : To learn about principles involved in manipulating genes and DNA
CO3 **:** Familiar with various cloning strategies in prokaryotes
CO4 : Learn techniques in genetic engineering
CO5 : To have awareness of IPR, the social and the ethical issues concerning cloning by genetic engineering

Unit 1: Introduction to Microbial Genetic Engineering **15 Hrs**

Historical prospectives: Definition of genetic engineering, milestones in genetic engineering, scope of genetic engineering.

Tools in Microbial Genetic Engineering: Mode of action and applications of restriction enzymes, DNA polymerases, methylases, Terminal deoxynucleotidyl transferase, Kinases, Phosphatases and DNA ligases in genetic engineering.

Cloning Vectors: Definition, uses and properties of Plasmid vectors: pBR and pUC series. Bacteriophage lambda, cosmids.

Cloning host- Cloning in *Escherichia coli* and *Saccharomyces cerevisiae*. Gene Library: Construction of cDNA library, genomic library.

Unit 2: Techniques and applications in Microbial Genetic Engineering **15 Hrs**

Isolation and Detection of DNA: Isolation of DNA, restriction digestion and ligation of DNA, Agarose gel electrophoresis, Blotting techniques- Southern blotting, DNA microarray analysis. PCR techniques and applications. DNA transfer methods: Microinjection, Electroporation and Liposome mediated DNA transfer. Identification and selection of recombinants.

Recombinant microorganisms: Application of recombinant microorganisms in basic research, industry, medicine, agriculture, environment. Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines. Biological, ethical and social issues of gene cloning and IPR.

Unit 3: Introduction to Industrial microbiology **15 Hrs**

Scope and concepts; Criteria for selection of industrially important microbes. Fermentor: Basic features; design and components of a typical Fermentor; Sterilization of fermentor, Control of air, temperature, pH, foaming and feed. Fermentation media: Strategies for media formulation; Natural and synthetic media; Role of buffers, precursors, inhibitors, inducers and micronutrients. Types of fermentation process: Submerged fermentation and Solid state fermentation (Koji)

Unit-4: Downstream processing and Microbial products **15Hrs**

Objectives and significance of downstream processing: Overview of steps in product extraction and purification, Biomass separation- Filtration and centrifugation; cell disruption- Physical, chemical and biological methods; Product extraction, purification, recovery and product testing.

Industrial production of microbial products: Antibiotics (Penicillin), Enzymes (Amylase), anti-cholesterol compounds, anti-cancerous compounds, hormones (Insulin).

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

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 acquire knowledge on the concepts and terminology in genetic engineering	√					√									
To learn about principles involved in manipulating genes and DNA	√		√						√						
Familiar with various cloning strategies in prokaryotes									√	√					
Learn techniques in genetic engineering						√						√			
To have awareness of IPR, the social and the ethical issues concerning cloning by genetic engineering										√					

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	

Bangalore University

Course Title	**MICROBIAL GENETIC ENGINEERING AND INDUSTRIAL MICROBIOLOGY (Practical)**		Practical Credits	**02**
Course Code	**MBL 106-II; DSC P6-II**	Contact Hours	**4 Hours/ week**	
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**	
Practical Content				

Practical: Microbial Genetic Engineering

1. Induction of mutations in bacteria by physicochemical methods.
2. Preparation of competent cells and demonstration of bacterial transformation.
3. Digestion of DNA by restriction enzymes.
4. Demonstration of ligation of DNA fragments.
5. Preparation of master and replica plates.
6. Demonstration of amplification of DNA by PCR.
7. Demonstration of Southern blotting.
8. Study of recombinant products-insulin.
9. Demonstration of a basic fermentor
10. Production and estimation of amylase by solid substrate fermentation
11. Production and estimation of amylase by submerged fermentation
12. Production and estimation of Penicillin
13. Demonstration of Downstream techniques namely centrifugation, microfiltration technique and cell disruption by sonicator/enzyme (photoghaphs, flow charts)

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	
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