SEMESTER-6

MB11500: Microbial Genetics

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- Students will gain comprehensive understanding of genetic mutations, repair mechanisms, and horizontal gene transfer in microorganisms, elucidating their implications for evolutionary processes and genetic diversity.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Mutations And Repair Mechanisms	08	25
2.	Mechanisms Horizontal Gene Transfer-I	07	25
3.	Mechanisms Horizontal Gene Transfer-II	07	25
4.	Plasmids and Transposable Elements	08	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO 1. Understand mutation types and mechanisms, including spontaneous and induced mutations, and the effects of mutagens.
CO 2. Explore bacterial horizontal gene transfer mechanisms (transformation, transduction, conjugation) and their evolutionary significance.
CO 3. Analyse bacterial conjugation, focusing on conjugative plasmids like F-plasmids and Hfr cells, in both Gram-negative and Gram-positive bacteria.
CO 4. Examine the role of plasmids and transposable elements in bacterial genetics, including their replication, regulation, and contribution to antibiotic resistance.

B.Sc. Microbiology Semester-6		
CORE COURSE		Hours
MB11500: Microbial Genetics		2 Hours /week
		Hours
Unit – I	Mutations And Repair Mechanisms	

1.1 Definitions and types of mutations 1.2 Molecular basis of mutations and mutagenesis 1.2.1 Spontaneous mutations and induced mutations 1.2.2 Mutagens and their types 1.3 Effects of Mutations 1.4 Detection and isolation of Mutants 1.5 DNA Repair mechanisms	08
Unit – II **Mechanisms Horizontal Gene Transfer-I**	
2.1 Introduction of Various mechanisms of Horizontal Gene Transfer 2.2 Transformation 2.2.1 Discovery and Griffith's Experiment 2.2.2 Mechanism of Transformation 2.2.3 Competency of bacterial for transformation and development of competent cells 2.3 Transduction 2.3.1 Discovery and Experimental evidence of transduction 2.3.2 Mechanism of Transduction 2.3.3 Generalized and specialised Transduction	07
Unit – III **Mechanisms Horizontal Gene Transfer-II**	
3.1 Discovery and Experimental evidence of Conjugation 3.2 Conjugative Plasmid, F-Factor; F^+ ,F^- cell and Hfr 3.3 General Mechanism of transfer of conjugative plasmid in Gram-negative bacteria 3.3.1 $F^+ \times F^-$ mating: Plasmid only transfer 3.3.2 Hfr × F^- Conjugation: Chromosomal DNA transfer 3.4 Bacterial Conjugation in Gram-positive bacteria 3.5 Development of Antibiotic Resistance in Bacteria by Horizontal Gene Transfer	07
Unit – IV **Plasmids and Transposable Elements**	
4.1 Bacterial Plasmids 4.1.1 F Plasmid, R Plasmid, colicin genic plasmids, Ti Plasmid 4.1.2 Plasmid Replication, rolling circle mechanism, Plasmid portioning 4.1.3 Plasmid Incompatibility 4.1.4 Plasmid Copy number, Regulation of copy number, stringent and relaxed plasmid 4.2 Prokaryotic transposable elements 4.2.1 IS element 4.2.2 Composite and non-composite transposons 4.2.3 Replicative and non-replicative transposons 4.2.4 Transposable Elements in Yeast	08

Reference books:

1. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 10th Edition WCB McGraw Hill, New York, (2002).

2. Gardner E J, Simmons M J and Snustad DP, Principles of genetics, 8th edition John Wiley & Sons, (2006). Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
3. Watson. J.D, Baker. T.A, Bell. S.P, Gann. A. Levine. M. Losick. R, Molecular Biology of Gene, 5th Edition. The Benjamin/Cummings Pub. Co. Inc. (2003).
4. Benjamin Lewin, Gene VII, Oxford University Press, (2000).

SEMESTER-6

MB11510: Diary Microbiology

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- ☞ The aim of the course is to give the students broad theoretical and practical knowledge about the principles and practices of maintaining hygienic conditions during milk production, processing, and storage to prevent contamination.
- ☞ They will also be familiar with the diverse range of microorganisms that can be present in milk and their implications for milk quality and safety.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Hygienic milk	07	25
2.	Microorganisms associated with milk	08	25
3.	Microbiological methods of milk testing	08	25
4.	Microbial spoilage of milk and Milk borne diseases	07	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO-1. Learn various microbiological methods for testing milk quality.
CO-2. Gain insights into the microbial spoilage of milk, understanding the causes, signs, and preventive measures against spoilage.
CO-3. Develop an awareness of milk borne diseases, their causative agents, modes of transmission, and strategies for their prevention and control.
CO-4. Contributing to the production of safe and wholesome milk for consumers.

B.Sc. Microbiology Semester-6		
CORE COURSE		**Hours**
MB11510: Diary Microbiology		**2 Hours /week**
		Hours
Unit – I	**Hygienic milk**	
1.1 Introduction and Significance of dairy microbiology 1.2 Sources of contamination of milk 1.3 Microorganisms associated with raw milk and their significance 1.4 Microflora of milking equipment and its effects on Raw Milk, Hygienic milk production,		07
Unit – II	**Microorganisms associated with milk**	
1.1 Characteristics of important microorganisms 1.2 Characteristics of spoilage and pathogenic microorganisms 1.3 Characteristics of dairy associated fungi and bacteriophages 1.4 Effect of processing on microorganisms in milk		08
Unit – III	**Microbiological methods of milk testing**	
1.1 Qualitative and quantitative methods of milk testing 1.2 Dye reduction test, Direct microscopic count, Standard plate count, Coliform counts in Milk 1.3 Methods of Enumeration of other groups of bacteria 1.4 Enumeration of yeast and moulds in Milk		08
Unit – IV	**Microbial spoilage of milk and Milk borne diseases**	
1.1 Role of microbes in spoilage of milk – Microbial interactions 1.2 Milk fermentations, Abnormal milk fermentations 1.3 Mastitic milk – Suitability for processing and public health Significance, Detection of mastitic milk 1.4 Food infection, intoxication and toxi-infection, Milk borne disease, Antimicrobial Substances in milk		07

Reference books:

1. Reddy R and Puniya A.K. 2017.Introductory dairy Microbiology. CRC Press, New York..
2. Robinson, R.K. 2002. Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products. 3rd ed. Wiley-Interscience, New York
3. Britz, T.J. and Robinson, R.K. 2008. Advanced Dairy Science and Technology. 1st ed. Blackwell Publ. Ltd., UK.
4. Fernandes, R. 2009. Microbiology Handbook: Dairy Products. Royal Society of Chemistry, Revised ed., London.
5. Marth, E.H. and Steele, J. 2001. Applied Dairy Microbiology. 2nd ed. CRC Press, Boca Raton, USA.

6. Walstra, P., Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.

SEMESTER-6

MB11520: rDNA Technology

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- Students understand tools of genetic engineering
- Understand application of rDNA techniques
- learning manipulations with DNA like, digestion, ligation of its fragments, molecular weight determination and other rDNA experiments.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Introduction to genetic engineering and tools	08	25
2.	Vectors and library preparation	08	25
3.	DNA delivery and detection	07	25
4.	Application of rDNA technologies	07	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO 1. Will get familiarized with basic cloning tools such as enzymes used to manipulate DNA, and cloning vectors.

CO 2. Will have learnt various gene delivery methods and basic essential techniques of DNA, RNA and protein analysis.

CO 3. Will gather in-depth knowledge of DNA amplification and sequencing methods.

CO 4. Will become aware of the applied aspects of all major techniques being used for

B.Sc. Microbiology Semester-6		
CORE COURSE		Hours
MB11520: rDNA Technology		2 Hours /week
		Hours
Unit – I	Introduction to genetic engineering and tools	
1.1 Restriction-modification systems: 1.2 Other endonucleases: DNase I, S1 nuclease. 1.3 DNA modifying enzymes and their applications: DNA polymerases, alkaline phosphatase, T4 polynucleotide kinase, terminal deoxynucleotidyl transferase. DNA ligases.		08
Unit – II	Vectors and library preparation	
2.1 Plasmid vectors 2.2 Phage vectors: l 2.3 BACs, YACs. Applications of different vector types. 2.4 Use of linkers, adaptors, homopolymer tailing, and insertional inactivation (including alpha complementation). 2.5 Expression vectors 2.6 Construction and screening of genomic and cDNA libraries		08
Unit – III	DNA delivery and detection	
3.1 Gene delivery methods: Chemical, Physical, Electric 3.2 viral-mediated delivery, Agrobacterium - mediated delivery. 3.3 Gel electrophoresis and Blotting 3.4 Analysis of DNA-protein interactions by electrophoretic mobility shift assay and DNA Footprinting. 3.5 DNA amplification and introduction to DNA sequencing		07
Unit – IV	Application of rDNA technologies	
4.1 Gene therapy: 4.2 Products of human therapeutic interest 4.3 Products of agricultural importance 4.4 Forensics		07

Reference books:

1. Brown, T.A. (2016). Gene Cloning and DNA Analysis: An introduction. 7th edition. Wiley Blackwell Publishing, U.K.
2. Clark, D.P and Pazdernik, N.J.(2015). Biotechnology. 2nd edition. Academic Press, USA.
3. Glick, B.R. and Patten, C.L. (2017). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th edition. ASM Press, USA.
4. Glick, B.R., Pasternak, J.J. and Patten, C.L. (2009). Molecular Biotechnology. 4th edition. ASM Press, USA.

5. Green, M. and J. Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. 4th edition. Cold Spring Harbour Laboratory Press, USA.
6. Primrose, S.B. and Twyman, R.M. (2016). Principles of Gene Manipulation and Genomics. 8th edition. Blackwell Publishing, U.K.
7. Willey, J. M., Sandman, K. and Wood, D. (2019). Prescott's Microbiology. 11th edition. McGraw Hill Higher Education, USA.

Practical Code	MICROBIOLOGY PRACTICAL -
1	Digestion of given DNA by using restriction enzymes and analysis by agarose gel electrophoresis.
2	Ligation of DNA fragments and analysis by agarose gel electrophoresis.
3	Graphical determination of molecular weight of DNA fragments from agarose gel electrophoresis profile.
4	Interpretation of sequencing gel electropherogram (Sanger's method).
5	Primer Designing
6	Demonstration of DNA amplification by PCR.

SEMESTER-6

MB11530: Clinical Microbiology

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- ☞ Basics of Clinical (Diagnostic) Microbiology
- ☞ Collection, transport, and laboratory examination of some of the clinical samples for the diagnostic purpose.
- ☞ Antimicrobial and chemotherapeutic agents.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Introduction To Clinical (Diagnostic) Microbiology**	07	25
2.	**Clinical Microbiology-I**	07	25
3.	**Clinical Microbiology-II**	08	25
4.	**Antimicrobial Chemotherapy**	08	25
	Total	**30**	**100**

Course outcome:

CO-1. Learning microbial risk groups, types of biosafety cabinets, various methods of microbial identification.
CO-2. To understand collection, transport, and laboratory examination of some of the clinical specimen for diagnosis
CO-3. To learn Antimicrobial chemotherapeutic agents.

B.Sc. Microbiology (Honours) Semester-6	
Subject	**Hours**
MB11530: Clinical Microbiology	**2 Hours /week**
Topic	**Hours**
Unit-1 Introduction To Clinical (Diagnostic) Microbiology	
Microbiology risk group classification Practicing biosafety (Biosafety I, II, III & IV laboratories) Biosafety Cabinets	08
Unit-02 Clinical Microbiology-I	
Possible pathogens, collection, transport, and laboratory examination of: Throat and Mouth Specimen Sputum CSF Blood	07
Unit-03 Clinical Microbiology-Ii	
Possible pathogens, collection, transport, and laboratory examination of: Pus Urine Urogenital Specimen Stool	08
Unit-04 Antimicrobial Chemotherapy	
General characteristics of antimicrobial chemotherapeutic agent Measuring antimicrobial activity Antibacterial drugs Antiviral Drugs Antifungal Drugs Antiprotozoal Drugs	07

Reference books:

1. Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries – Part-1, 2nd Ed., Cambridge University Press.
2. Joanne M. Willey, Kathleen M. Sandman, Dorothy H. Wood (2020). Prescott's microbiology, 11th Edition, McGraw-Hill Education
3. Willey J., Sherwood I., (2011), Prescott, Harley and Kleins Microbiology, 9th ed., Mc Graw – Hill.
4. Godkar P B. Textbook of Medical Laboratory Technology, 2nd Ed. 2003 Bhalani Publication.
5. Mackie and McCartney Medical Microbiology. A Guide to Laboratory Diagnosis and Control of Infection.13th Ed., The English Language Book Society and Churchill Company.

SEMESTER-6

MB11540: Applied Environmental Microbiology

Credits: 2 (Theory)

Contact hours per week: 2 (Theory)

Objectives of the course:

- ☞ This course provides insights into the diverse microbial communities inhabiting air, water, inhouse and extreme environments. Gain insights into the principles and methods of biodeterioration to various materials.
- ☞ Additionally, students will investigate the impact of environmental factors on microbial communities and learn to devise sustainable strategies for environmental management and explore the microbial life of extreme condition.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Bacteriology of air**	08	25
2.	**Extremophiles**	07	25
3.	**Aquatic Microbiology**	08	25
4.	**Indoor Microbiology and Microbially Influenced corrosion**	07	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to –

CO-1.	To cultivate a comprehension of the fundamental principles and concepts underlying air microbiology.
CO-2.	To gain an understanding of extreme environments and how microorganisms adapt to thrive within them.
CO-3.	Demonstrate a comprehensive understanding of microbial interactions within aquatic ecosystems and their implications for environmental health.
CO-4.	Proficient in identifying microbial threats in indoor environments and implementing effective mitigation strategies and microbial biodeterioration of various materials.

B.Sc. Microbiology Semester-6		
CORE COURSE		Hours
MB11540: Applied Environmental Microbiology		2 Hours /week
		Hours
Unit – I	Microbiology of air	
1.1	Introduction, Number and kinds of organisms in air	08
1.2	Enumeration of bacteria in air	
1.3	Air sanitation	
1.4	Aeroallergens and aeroallergy	
1.5	Phylloplane Microflora	
Unit – II	Extremophiles	
2.1	Acidophiles and Alkalophiles	07
2.2	Halophiles	
2.3	Psychrophiles	
2.4	Thermophiles and Hyperthermophiles	
2.5	Barophiles	
Unit – III	Aquatic Microbiology	
3.1	Natural water, The aquatic Environment	08
3.2	Distribution of microorganisms in the aquatic environment	
3.3	Aquatic microorganisms and Techniques for study of aquatic microorganisms	
3.4	Role and importance of aquatic ecosystem	
Unit – IV	Indoor Microbiology and Microbially Influenced corrosion	
4.1	Introduction, Microbiology of the Indoor Air in Private Dwellings, Microbiology of Public Places	07
4.2	Microbially Influenced corrosion of Metals	
4.3	Biodeterioration of Stone and concrete	
4.4	Biodeterioration of Leather, Paper, Fuels, Plastics, Cosmetics and Pharmaceutical Product	

Reference books:

1. Madigan, M. T., Martinko, J. M., Stahl, D. A., & Clark, D. P. (2012). Brock biology of microorganisms, Global Edition. San Francisco, TX: Pearson Benjamin Cummings.
2. Dubey, R. C., & Maheshwari, D. K. (2006). A textbook of Microbiology. S. Chand Publishing.

3. Schaechter, M. (2004). The desk encyclopaedia of microbiology, 2nd Ed., Elsevier Academic Press.
4. Pelczar M. J., Chan E. C. S and Krieg N. R., (2001). Microbiology, Fifth Edition, McGraw-Hill Education.
5. Wiley, J., Sandman, K. and Wood, D. (2023). Prescott's Microbiology, 12th Ed, McGraw-Hill Professional.
6. Jacquelyn G. Black and Laura J. Black, (2017). Microbiology: Principles and Explorations, Microbiology, Tenth Edition, Wiley, John Wiley and Sons., Inc.
7. Dubey, R. C. (2010). Textbook of Biotechnology, 1st Ed., S. Chand, Multicolor.

SEMESTER-6

MB11550: Instrumentation and Techniques

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- The aim of the course is to give the students would explore the tools and procedures used to conduct experiments or observations relevant to the topic.
- This could include learning about specific instruments utilized, experimental setups, data collection protocols, and analytical techniques employed by the researchers.
- By examining these aspects, students can gain insights into the practical application of theoretical concepts, enhance their comprehension of experimental design, and develop critical thinking skills necessary for scientific inquiry.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Microscopy Techniques	07	25
2.	Centrifugation Techniques	07	25
3.	Electrophoretic Techniques	08	25
4.	Spectrophotometry and Chromatographic Techniques	08	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO-1. Equipped with the knowledge and skills to utilize various instruments and procedures for analyzing biological samples and molecules.
CO-2. Visualize cellular structures and organisms, separate components based on density, size and charge and quantify and analyse biomolecules.
CO-3. Develop critical thinking skills by interpreting experimental results and understanding the principles behind each technique, laying a solid foundation for further study and research in the life sciences.

B.Sc. Microbiology Semester-6		
CORE COURSE		Hours
MB11550: Instrumentation and Techniques		2 Hours /week
		Hours
Unit – I	**Microscopy Techniques**	
1.1	Basic principle of Microscopy, Resolving power of microscope	07
1.2	Types of microscopes (Simple, Compound, Light, Bright field, Dark field and Phase contrast microscope)	
1.3	Transmission Electron Microscopy (Working principle, Sample preparation, advantages and disadvantages of TEM)	
1.4	Scanning Electron Microscopy (Working principle, Resolution, Magnification, Sample preparation, Advantages and Disadvantages of SEM)	
Unit – II	**Centrifugation Techniques**	
1.1	Principle of Centrifugation, Centrifugal force	07
1.2	Principles of Sedimentation, Svedberg co-efficient	
1.3	Basic component of a centrifuge machine	
1.4	Types of centrifuges and their uses (Differential, Density Gradient Centrifugation), Sub-cellular Fractionation	
Unit – III	**Electrophoretic Techniques**	
1.1	Basic Principle of electrophoresis	08
1.2	Effect of buffer on electrophoretic movement	
1.3	Instrumentation Setup of Electrophoresis, Supporting Medium	
1.4	Type of Electrophoresis (Boundary, Paper, Gel, Disc, PAGE and SDS-PAGE)	
Unit – IV	**Spectrophotometry and Chromatographic Techniques**	
1.1	Spectrophotometry and Spectrophotometer (Absorption, Beer's, Lambert's and Beer-Lambert's Law), Molar Extinction Coefficient, Transmittance	08
1.2	Visible Light and Ultraviolet Spectroscopy	
1.3	Principle of Chromatography	
1.4	Types of Chromatography Techniques (Paper, Thin Layer, Column, Adsorption, Ion-exchange, Molecular Size Exclusion, Affinity, Gas and High-Pressure Liquid Chromatography)	

Reference books:

1. Wilson & Walker (2000). Principles and Techniques in Practical Biochemistry. 5th Edition Cambridge University Press.
2. Ananta Swargiary (2017). Biological Tools and Techniques. Kalyani Publishers, New Delhi.
3. K L Ghatak (2011). Techniques and Methods in Biology. PHI Publication.
4. Pranav Kumar (2021). Fundamentals and Techniques of Biophysics and Molecular Biology. Pathfinder Publication, New Delhi, India
5. 4. D.T Plummer (1987). An Introduction to Practical Biochemistry. McGraw Hill Publication.

MB11560: Microbiology Practical VI

Credits: 06 (Practical)
Contact hours per week: 12 (Practical)

Objectives of the course:

- The aim of the course is to give the students broad practical skills on microbial genetics, R-DNA technology, Clinical Microbiology, Environmental Microbiology, Dairy microbiology and various instrumentation techniques.
- Also introduce students about the hands on practical knowledge on genetics, recombinant techniques, Isolation and identification of microorganism in clinical samples, study of environmental important microorganism and various technique for qualitative and quantitative analysis of separation of samples and product.

Course outcome: After completion of this course, Students are able to –

CO-1.	demonstrate proficiency in analyzing and manipulating microbial genetic material for research and biotechnological applications
CO-2.	adeptly apply recombinant DNA technology to manipulate and engineer genetic material for various biotechnological purposes.
CO-3.	demonstrate proficiency in isolating and identifying pathogenic microorganisms from clinical specimens using various diagnostic techniques.
CO-4.	proficiently assess microbial communities in diverse environments, employing with different techniques.
CO-5.	skilled of analyzing microbial populations in dairy products and understanding their impact on product quality and safety.
CO-6.	capable in operating and troubleshooting various analytical instruments used in scientific research and industry.

Practical Code	MICROBIOLOGY PRACTICAL – VI
1	Bacteriological investigation of diagnostic problems related to blood.
2	Bacteriological investigation of diagnostic problems related to urine.
3	Bacteriological investigation of diagnostic problems related to pus.
4	Bacteriological investigation of diagnostic problems related to stool.

5	Determination of antibiotic susceptibility testing (Agar Disc Method)
6	Determination of MIC of antibiotic.
7	Isolation of non-pigmented mutants of *Serratia marcescens.*
8	Isolation of drug resistant mutants (gradient plate method).
9	Preparation of Master and Replica plates.
10	Bacteriological analysis of milk (MBRT, qualitative, quantitative, AFB)
11	Bioassay of penicillin
12	Study of air microflora by settling plate technique
13	Isolation of microorganisms from Public Places.
14	Separation of amino acids by paper chromatography
15	Separation of organic compound/Amino acid by thin layer chromatography
16	Estimation of protein concentration by spectroscopic method (Folin – Lowry's)
17	Digestion of given DNA by using restriction enzymes and analysis by agarose gel electrophoresis.
18	Ligation of DNA fragments and analysis by agarose gel electrophoresis.
19	Graphical determination of molecular weight of DNA fragments from agarose gel electrophoresis profile.
20	Interpretation of sequencing gel electropherogram (Sanger's method).
21	Primer Designing

Reference books:

1. Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya.
2. Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 2, 9th ed., Aditya.
3. Cappuccino, J.G., (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pte. Ltd.
4. Aneja, K.R., (2003). Experiments in Microbiology 4th ed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers.

SEMESTER- 6

DSC

MB14240: Microbial Laboratory Hazards and precaution

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

Course Objectives: Safety measures while handling of live bacteria, biosafety levels, National and International biosafety guidelines and regulations, Risk Assessment; Risk management and communication

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Introduction to Biosafety	08	25
2.	Biohazards and chemical Hazards precaution	08	25
3.	Laboratory Safety practices	07	25
4.	Biosafety committees	07	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO-1. To aware about biosafety and biohazards for safe precaution
CO-2. Understand and follow Good laboratory practices in the laboratory
CO-3. To get to know about deposal of biohazard material and their safe disposal

B.Sc. Microbiology Semester-6		
DSC		Hours
MB14240: Microbial Laboratory Hazards and Precaution		2 Hours /week
		Hours
Unit – I	Introduction to Biosafety	
1.1 Biosafety: Introduction; biosafety issues in biotechnology 1.2 Biosafety and biosecurity in the laboratory 1.3 Types of biosafety laboratory 1.4 Biosafety in Clinical laboratory their Safety precautions, Hazards waste material their safe disposal practices		08
Unit – II	Biohazards and chemical Hazards precaution	
2.1 Biosafety Levels for handling various risk groups Microorganisms 2.2 SOP in laboratory, Instrumentals, chemical hazards and precaution 3.3 Laboratory manual safety guidelines and policy for use of laboratory requisites – such as Dry ice, liquid nitrogen, Various gases uses in anaerobic laboratory		08
Unit – III	Laboratory Safety Practices	
3.1 Clinical laboratory biosafety practices, Safety plans and laboratory designing 3.2 Types of biosafety cabinet, Biosafety levels for handing of infectious risk groups Microorganisms 3.3 Laboratory safety standards		07
Unit – IV	Biosafety committees	
4.1 Intuitional Biosafety Committees (IBSC), Animal ethical committees and their role and regulations 4.2 RCGM.GEAC, GMO application in food and agriculture 4.3 Designing training modules for laboratory workers and trainers, for safe practices		07

Reference books:

1) Essentials of Intellectual Property: Law, Economics, and Strategy By Alexander I. Poltorak; Paul J. Lerner Wiley, 2011 (2nd edition
2. M K Sateesh. Bioethics and Biosafety . Kindle Edition
3. Diane O. Fleming, Debra L. Hunt Biological Safety: Principles and Practices, 4th Edition. ASM 2006
4. Shomini Parashar, Deepa Goel IPR, Biosafety and Bioethics Pearson India 2013

Practical DSC MB14250 (Microbial Laboratory Hazards and Precaution)

Credits: 01 (Practical)
Contact hours per week: 02 (Practical)

Objectives of the course:

- ☞ The aim of the course is to give the students broad practical skills on Safety Protocols, Risk Assessment, Sterilization Techniques and Biohazardous Waste Management.

Course outcome: After completion of this course, Students are able to –

CO-1.	demonstrate proficiency in identifying potential microbial hazards in laboratory settings and implementing appropriate safety precautions to mitigate risks effectively. They will also possess the skills to respond to laboratory emergencies and adhere to regulatory guidelines for safe microbial handling.

Practical Code	Practical DSC (Microbial Laboratory Hazards and Precaution)
1	Good laboratory practices (GLP) as an protocol
2	Precaution on Biohazards and chemical hazards handling practices in laboratory
3	Instrumental Hazards and safety precaution during handling in laboratory
4	Labelling and symbol practices of laboratory chemicals in laboratory

SEMESTER-6

DSC

MB14260: Immunohematology & Blood Banking

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- The aim of the course is to give the students broad theoretical and practical skills in Immunohematology This course covers the principles of various aspects associated with the Immunohematology procedures.
- It also introduces students about the importance of Immunohematology procedures in clinical aspects and transfusion related aspects respectively.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Introduction to Immunohematology**	08	25
2.	**Introduction to Transfusion Medicine/Blood banking**	07	25
3.	**Routine laboratory procedures in Blood Bank**	08	25
4.	**Blood transfusion services**	07	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO-1. Develop a good knowledge of the development of Immunohematology and blood banking.
CO-2. Understand the characteristics of various Immunohematological and blood banking procedures with their clinical significance.
CO-3. Gain knowledge regarding different fields and scope of Immunohematology and blood banking.
CO-4. Perform basic experiments to study Immunohematological disorders and transfusion associated adverse reactions.

B.Sc. Microbiology Semester-6

DSC	Hours
MB14260: Immunohematology & Blood Banking	2 Hours /week

		Hours
Unit – I	**Introduction to Immunohematology**	
1.1	Basics & principle of immunohematology.	08
1.2	Discoveries of human blood groups.	
1.3	Major and Minor blood group systems.	
1.4	ABO, Rhesus (Rh) blood group systems and other blood group systems.	
Unit – II	**Introduction to Transfusion Medicine/Blood banking**	
1.1	Selection of blood donors.	**07**
1.2	Method of blood collection.	
1.3	Common equipment in blood bank.	
1.4	Transport & storage of collected blood.	
Unit – III	**Routine laboratory procedures in Blood Bank**	
1.1	ABO & Rh blood grouping (Slide & Tube test).	**08**
1.2	Coomb's test (Direct & Indirect).	
1.3	Cross matching (Major & Minor).	
1.4	Quality control and troubleshooting in antigen & antibody typing.	
Unit – IV	**Blood transfusion services**	
1.1	Pretransfusion testing of donor's blood.	**07**
1.2	Preparation of blood components/products for transfusion.	
1.3	Selection of blood components/products for transfusion.	
1.4	Transfusion reactions.	

Reference books:

1. Mukherjee, K. L. (1988). Medical Laboratory Technology, Vol 1, 2 & 3, Tata McGraw Hill Publishing.
2. Ochei, J. and Kolhatkar, A. (2000). Medical Laboratory Science-Theory and Practice, Tata McGraw Hill.
3. Godkar, P. B. (2016). Textbook of Medical Laboratory Technology, 3rd Ed., Bhalani Publishing House.
4. Professional guide to diagnostic tests, (2004). 1st Ed., Lippincott Shalliams & Wilkins.
5. Mollison, P.L., Engelfriet, P.L., & Contreras, M. (1997). Blood Transfusion in clinical medicine (10th Eds.), Oxford: Blackwell Science.
6. Dacie JV, Lewis SM (2010). Practical Hematology.10th ed. Philadelphia: Churchill Livingstone.
7. Makroo R.N., Compendium of Transfusion Medicine, Practice of Safe Blood Transfusion,
8. Technical Manual, American Association of Blood Banks, 2014

MB14270: Practical DSE 2
Practical DSC (Immunohematology & Blood banking)

Credits: 01 (Practical)
Contact hours per week: 02 (Practical)

Objectives of the course:

- ☞ The aim of the course is to give the students broad practical skills on Immunohematology & Blood banking.
- ☞ Also introduce students about the hands-on practical knowledge on Immunohematology procedures in clinical aspects and transfusion. Furthermore students are aware to blood collection, criteria of donor and selection of donor.

Course outcome: After completion of this course, Students are able to –

CO-1. Possess the skills to perform blood typing, cross-matching, and antibody screening for transfusion purposes. They will also demonstrate proficiency in managing blood inventory and ensuring the safety of blood products through proper screening and testing protocols.

Practical Code	Practical DSC (Immunohematology & Blood banking)
1	ABO and Rh grouping by slide technique
2	Froward & Reverse blood grouping by tube method
3	Compatibility testing between Donor & recipient- Cross matching
4	Determination of Weak 'D' antigen

SEMESTER-6

DSC

MB14280: Genomics, Proteomics, Bioinformatics and Biostatistics

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- This course offers students an introduction to the fundamentals of genomics, proteomics, bioinformatics and biostatistics. Participants will explore diverse sequencing methods, delve into the core principles of proteomics, and discover the intricate connections between these disciplines and the science of bioinformatics.
- Moreover, students will gain insights into biological databases, explore a variety of bioinformatics tools, and much more. It also enhances comprehension of how biostatistics can be utilized in the analysis and interpretation of data.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Microbial Genomics	08	25
2.	Microbial Proteomics	08	25
3.	Bioinformatics	07	25
4.	Biostatistics	07	25
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO-1. Adeptly analyze microbial genomes, discern evolutionary trends, and apply genomic insights to address real-world microbial challenges.
CO-2. Equipped to identify and analyze proteins, understand their functions within biological systems, and apply proteomic techniques to advance research in various fields.
CO-3. Master the analysis of biological data using computational methods, enabling them to uncover patterns, predict structures, and interpret complex biological phenomena.
CO-4. Acquire the skills to design robust experiments, perform statistical analyses, and draw valid conclusions in various biological research contexts.

B.Sc. Microbiology Semester-6

CORE COURSE	Hours
MB14280: Genomics, Proteomics, Bioinformatics and Biostatistics	2 Hours /week
	Hours

Unit – I Microbial Genomics

1.1	DNA Sequencing Methods	08
1.2	Genome Sequencing	
1.3	Metagenomics	
1.4	Transcriptome Analysis	

Unit – II Microbial Proteomics

2.1	The need for proteomics	07
2.2	Proteomics Explores Total Cellular Protein	
2.3	Probing DNA-Protein Interactions	
2.4	The scope of proteomics	

Unit – III Bioinformatics

3.1	Pairwise Sequence Alignment	08
	3.1.1 Sequence Homology versus Sequence Similarity	
	3.1.2 Sequence Similarity versus Sequence Identity	
	3.1.3 Methods: Global amd Local	
3.2	Multiple Sequence Alignment	
	3.2.1 Scoring Function	
	3.2.2 Exhaustive Algorithms	
3.3	Phylogeny analysis	
	3.3.1 Representation of phylogeny	
	3.3.2 Types of phylogenetic trees- rooted and unrooted trees	
	3.3.3 Molecular clocks	

Unit – IV Biostatistics

4.1	Introduction to statistics: mean, median, mode, standard deviation	07
4.2	Sampling methods – simple, random, stratified, systematic and cluster sampling procedures.	
4.3	Descriptive Statistics and Presentation Classification, Graphical Presentation, Measures of Central Tendency, Measures of Dispersion Regression and Correlation	
4.4	Probability distribution, Chi-square test, ‘t’ and ‘f’ test, ANOVA.	

Reference books:

1. Wiley, J., Sandman, K. and Wood, D. (2023). Prescott's Microbiology, 12th Ed, McGraw-Hill Professional.
2. Wiley, J., Sandman, K. and Wood, D. (2014). Prescott's Microbiology, 10th Ed, McGraw-Hill Professional.
3. Twyman R. (2008). Principles of Proteomics. Taylor & Francis Publisher, Oxon.
4. Primrose S. and Twyman R. (2006). Principles of Gene Manipulation & Genomics, 7th edition. Black well Publishing, Malden.
5. Xiong, J., (2009).Essential Bioinformatics, Cambridge University press.
6. Robert R. Sokal and F. James Rohlf: Introduction to Biostatistics, Dover Publications. Olive Jean Dunn and Virginia A Clark: Basic Statistics, A primer for the Biomedical Sciences, 4th Edition, John Wiley \& Sons.
7. Arora, P. N. (2007). Biostatistics. Himalaya Publishing House.
8. Gurumani N. (2011) Research Methodology For Biological Sciences, MJP Publishers, Chennai.

Practical DSC MB14290 (Genomics, Proteomics, Bioinformatics and Biostatistics)

Credits: 01 (Practical)
Contact hours per week: 02 (Practical)

Objectives of the course:

- ☞ The aim of the course is to give the students broad practical skills on Genomics, Proteomics, Bioinformatics and Biostatistics.
- ☞ Also introduce students about the hands-on practical knowledge on genomics, protein structure study and prediction using various online tools and statistical analysis for research and data collection.

Course outcome: After completion of this course, Students are able to –

CO-1.	utilize genomic and proteomic techniques for analyzing biological systems and identifying biomolecular interactions. They will also demonstrate competence in applying bioinformatics and biostatistics tools to analyze large datasets and extract meaningful biological insights.

Practical Code	Practical DSC (Genomics, Proteomics, Bioinformatics and Biostatistics)
1	To Study the protein Structure database (PDB)

2	Sequence based search analysis by BLAST
3	Sequence analysis by Multiple sequences alignment.
4	Protein structure model evaluation (PROCHECK).
5	Calculate descriptive statistics for the data collected
6	Prepare histogram for data given
7	Correlation coefficient (Calculative method and Computation method)
8	Sequence alignment & phylogenetic analysis using online tools

SEMESTER-6

DSC

MB14300: Plant and Animal Biotechnology

Credits: 2 (Theory)
Contact hours per week: 2 (Theory)

Objectives of the course:

- To make students understand the principles and techniques of genetic engineering in both plants and animals, including plant tissue culture and transgenic animal development.
- To provide knowledge on applications of transgenic organisms in agriculture, biotechnology, and medicine, focusing on crop improvement, disease resistance, and biomedical research.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Plant Tissue Culture**	08	27
2.	**Transgenic Plants and their applications**	07	23
3.	**Animal Cell and Tissue Culture**	08	27
4.	**Transgenic Animals and their applications**	07	23
	Total	**30**	**100**

Course outcome: After completion of this course, Students are able to -

CO 1. Master techniques of plant tissue culture for agricultural and research applications.
CO 2. Understand Agrobacterium-mediated gene transfer for crop improvement and disease resistance.
CO 3. Gain proficiency in animal cell culture for biotechnological and medical research.
CO 4. Evaluate methods for developing transgenic animals, emphasizing applications in disease management.

B.Sc. Microbiology Semester-6		
DSC		**Hours**
MB14300: Plant and Animal Biotechnology		**2 Hours /week**
		Hours
Unit – I	**Plant Tissue Culture**	
1.1 Introduction of Plant tissue culture 1.2 Types of plant tissue culture: 1.2.1 Cell suspension culture, protoplast culture, embryo culture, Meristem culture 1.2.2 Organ culture, Root culture, Shoot tip culture 1.2.3 Leaf culture, Flower culture, Ovary and Ovule culture 1.2.4 Embryo culture; Anther, Pollen and Endosperm culture		08
Unit – II	**Transgenic Plants and Their Applications**	
2.1 *Agrobacterium* mediated gene transfer 2.2 Transgenic Plants for crop Improvement 2.3 Development of resistant plants 2.4 Molecular farming from transgenic plants		07
Unit – III	**Animal Cell and Tissue Culture**	
3.1 Introduction to animal cell culture 3.2 Primary and secondary culture 3.3 Organ culture 3.4 Different types of cell lines: finite and continuous cell lines 3.5 Suspension culture		08
Unit – IV	**Transgenic Animals and Their Applications**	
4.1 Introduction 4.2 Overview of methods to develop transgenic animals 4.3 Transgenic Mice and their applications 4.4 Applications of Transgenic animals to interrupt disease cycles		07

Reference books:

1 Dubey, R.C., 1993. A textbook of Biotechnology. S. Chand Publishing.
2 Freshney RI. 2005. Culture of Animal Cells. Wiley Liss.
3 Mathur, S. 2009. Animal cell and tisse culture. Agrobios.
4 Chawla, H., 2011. Introduction to plant biotechnology (3/e). CRC Press.
5 Stewart Jr, C.N. ed., 2016. Plant biotechnology and genetics: principles, techniques, and applications. John Wiley & Sons.

SEMESTER-6

Practical DSC MB14310 (Plant and Animal Biotechnology)

Credits: 01 (Practical)

Contact hours per week: 02 (Practical)

Objectives of the course:

- ☞ The aim of the course is to give the students broad practical skills on various techniques on plant and Animal Biotechnology.

Course outcome: After completion of this course, Students are able to –

CO-1.	proficient in applying biotechnological methods for improving plant and animal traits, including genetic modification and tissue culture techniques. They will also demonstrate the ability to analyze and interpret biotechnological data to inform agricultural and biomedical practices

Practical Code	Practical DSC (Plant and Animal Biotechnology)
1	MTT Assay (Demonstration).
2	Quantification of Chick line embryo cells by Trypan Blue exclusion dye.
3	To study Cytome assay
4	Preparation of commonly used Plant Tissue Culture Media (MS-medium, Minimum media
5	Explant preparation and surface sterilization
6	In Vitro culture of suitable Explants for induction of callus
7	Shoot and root growth study from in vitro raised cultures of plant
8	Isolation and fusion of protoplast by enzymatic method

Reference books:

1. Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya.
2. Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 2, 9th ed., Aditya.

3. Cappuccino, J.G., (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pte. Ltd.
4. Mukherjee, K. L. (1988). Medical Laboratory Technology, Vol 1, 2 & 3, Tata McGraw Hill Publishing.
5. Ochei, J. and Kolhatkar, A. (2000). Medical Laboratory Science-Theory and Practice, Tata McGraw Hill.
6. Dacie JV, Lewis SM (2010). Practical Hematology.10th ed. Philadelphia: Churchill Livingstone