SEMESTER-5

MB11430: Molecular Biology

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

Objectives of the course:

- ☞ This subject shall give preliminary insight into prokaryotic genetics. The subject shall provide knowledge about molecular processing and functioning of gene in bacteria.
- ☞ The course shall give understanding of the fundamental concepts behind various molecular genetics of bacterial cells, regulation and control of genes, genetic codes, molecular processes involved in genetic replication, translation, and transcription.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Replication in Prokaryotes**	08	25
2.	**Transcription in Prokaryotes**	08	25
3.	**Regulation in Transcription**	07	25
4.	**Translation in Prokaryotes**	07	25
	Total	**30**	**100**

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

CO-1. Learn about structural properties and replication of bacterial DNA.
CO-2. Understand the in-depth knowledge about molecular mechanism of genetic codes and transcription in bacteria.
CO-3. Understand the process of gene regulation and its control.
CO-4. Able to understand translation and protein maturation in bacteria.

B.Sc. Microbiology (Honours) Semester-5	
CORE COURSE	**Hours**
MB11430: Molecular Biology	**2 Hours /week**
Topic	**Hours**
Unit – I Replication in Prokaryotes	
1.1 Replisome (Enzymes involved in DNA replication) 1.2 Semiconservative nature of DNA replication 1.3 DNA replication in Prokaryotes 1.4 DNA replication in Eukaryotes (Brief)	08
Unit – II Transcription in Prokaryotes	
2.1 Protein coding genes, tRNA and rRNA genes 2.2 Transcription in bacteria 2.3 Genetic Code 2.4 Post Transcriptional Modifications	08
Unit – III Regulation in Transcription	
3.1 Introduction: Operon Systems 3.2 Lac Operon 3.3 Trp Operon 3.4 Riboswitches	07
Unit – IV Translation in Prokaryotes	
4.1 Amino Acid Activation 4.2 Stages of translation 4.3 Regulation in translation 4.4 Post-translational modifications and protein maturation	07

Reference books:

1. Wiley, J. M., Sherwood, L. and Woolverton, C. J., (2017) Prescott, Harley and Klein's Microbiology, 10th Ed., McGraw-Hill Education.
2. Wiley, J. M., Sherwood, L. and Woolverton, C. J., (2022) Prescott, Harley and Klein's Microbiology, 12th Ed., McGraw-Hill Education
3. Russell, P. J. (2005) Genetics: A Molecular Approach, 2nd Ed., Benjamin Cummings.
4. Klug, W. S. and Cummings, M. R. (2008) Concepts of Genetics, 9th Ed., Benjamin Cummings.
5. Hartl, D. L. and Jones, E. W., (2009) Genetics: Analysis of genes and genomes, 7th Ed., Jones and Bartlett publishers.

SEMESTER-5

MB11440: Food 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 skills in food microbiology. This course covers the principles of food spoilage and food preservation.
- Course also covers knowledge about food borne diseases and its control.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Contamination and Spoilage of food**	08	25
2.	**Preservation of food**	08	25
3.	**Food Borne Disease**	07	25
4.	**Microorganisms as food**	07	25
	Total	**30**	**100**

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

CO-1. Develop a good knowledge of the microorganisms in the production of food and its spoilage.
CO-2. Understand the various techniques and principles for food preservations.
CO-3. Can identify the role of microorganisms in food borne diseases.
CO-4. Understand the role of fermenting microorganisms in different foods and their products.

B.Sc. Microbiology (Honours) Semester-5		
CORE COURSE		Hours
MB11440: Food Microbiology		2 Hours /week
Topic		Hours
Unit – I Contamination and Spoilage of food		
1.1	Intrinsic and extrinsic factors involved in food spoilage	08
1.2	Causes and classification of food spoilage	
1.3	Spoilage of Bread and Bakery products	
1.4	Spoilage of Fruits and Vegetables	
1.5	Spoilage of Heated Canned Foods	
Unit – II Preservation of food		
2.1	Principles of Food Preservation	08
	2.1.1 Asepsis, Removal of Microorganisms, Maintenance of anaerobic conditions	
2.2	Methods for Food Preservations	
	2.2.1 High and Low temperatures	
	2.2.3 Methods of drying	
	2.2.4 Chemical Preservatives	
	2.2.5 Irradiation	
Unit – III Food Borne Disease		
3.1	Food borne infections	07
3.2	Food intoxication	
3.3	Detection of Food-Borne Pathogens	
3.4	The HACCP System and Food safety: Outline	
Unit – IV Microorganisms as food		
4.1	Single cell Protein	07
4.2	Mushrooms	
4.3	Alcoholic beverages	
4.4	Bread and other fermented foods	

Reference books:

1. Frazier, W. C. and Westhoff, D. C., (2006). Food Microbiology, 4th Ed., Tata Mc-Graw Hill, India.
2. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 10th Edition WCB McGraw Hill, New York, (2002).
3. Black J.G. Microbiology- Principles and Explorations. John Wiley & Sons Inc. New York, (2002).
4. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
5. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson Eugene W. Nester, Denise G. Anderson, C. Evans Roberts, Martha T. Nester. Microbiology, a Human Perspective, 6th Edition, Mc GRAW-HILL.

SEMESTER-5

MB11450: Immunology-II

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

Objectives of the course:

☞ The objective of the course is to make students learn about immune responses, including hypersensitivity, autoimmunity, and immunodeficiency disorders, as well as vaccine types and development.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Humoral Immune Response**	07	23
2.	**Adaptive Immune Response**	08	27
3.	**Types of vaccines and Hypersensitivities**	07	23
4.	**Immunodeficiency disorders and Autoimmunity**	08	27
	Total	**30**	**100**

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

CO-1. Understand the mechanisms underlying humoral immune responses, including B-cell receptor activation, clonal selection, antibody kinetics, diversity, and class switching.
CO-2. Explain the cell-mediated immune response, focusing on T-cell receptors, activation, clonal selection, and recognition of foreign antigens, including the role of MHC molecules.
CO-3. Gain knowledge about hypersensitivity reactions, autoimmunity, and transplantation rejection mechanisms to comprehend immune system dysregulation.
CO-4. Evaluate different types of vaccines, their development, advantages, and immunodeficiency disorders, distinguishing between primary and secondary immunodeficiencies.

B.Sc. Microbiology (Honours) Semester-5		
CORE COURSE		Hours
MB11450: Immunology-II		2 Hours /week
		Hours
Unit – I Humoral Immune Response		
1.1	B-Cell Receptors	07
1.2	Activation of B-cell	
1.3	Clonal Selection of B-cells	
1.4	Antibody Kinetics, Primary and secondary antibody Response	
1.5	Antibody Diversity and antibody class switching	
1.6	Monoclonal and polyclonal antibodies	
	1.6.1 Production of Monoclonal antibodies 1.6.2 HAT media selection	
1.7	Neutralization and Opsonization	
Unit – II Cell-mediated Immune Response		
2.1	T-cell Receptors and types of T-cells	08
2.2	Activation of T lymphocytes	
2.3	Clonal selection of T lymphocytes	
2.4	Recognition of Foreignness	
2.5	MHC molecules and antigen processing pathways	
Unit – III Types of vaccines and Hypersensitivities		
3.1	Vaccines and their types	07
	3.1.1 Development of Active Immunity, Passive Immunity and Herd Immunity	
	3.1.2 Characterisation, advantages and advantages of various types of vaccines	
3.2	Hypersensitivity	
	3.2.1 Types of Hypersensitivity and their mechanisms	
Unit – IV Immunodeficiency disorders and Autoimmunity		
4.1	Immunodeficiency Disorders: Introduction	08
	4.1.1 Primary and Secondary Immunodeficiencies	
4.2	Autoimmunity and auto-immune diseases	
4.3	Transplantation rejections	

Reference books:

1. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. Immunology. 7th -12th Ed. W. H. 2003.
2. Roitt, LM. Essentials of Immunology, Willey and Black Well Scientific. 13th Ed.. 2017.
3. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. Prescott, Harley, and Klein's
4. microbiology.7th -12th edition. New York: McGraw-Hill Higher Education 2008.
5. Abbas, A.K. Lichtman, A.M. and Pober, J.S. Cellular and Molecular immunology 3rd Ed. Philadelphia: W.B. Saunders. 1997.
6. Shim Chakravarty, Immunology and Immunotechnology- Oxford University Press, ISBN-13: 978-0-19-567688-4.

SEMESTER-5

MB11460: Soil and Agricultural Microbiology

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

Objectives of the course:

- Students will learn concepts of soil microbiology and agriculturally important microbes.
- Students will understand some of the plant-microbe interactions.
- Students will familiarize with concepts of plant pathology.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Soil Microbiology	09	25
2.	Agricultural Microbiology	06	25
3.	Microbe-Plant interactions	08	25
4.	Plant pathology	07	25
	Total	**30**	**100**

Course outcome: after completion of the course, students will be -

CO-1. Understand basic concepts of soil microbiology.
CO-2. Learn importance of microbes in Agriculture.
CO-3. Learn some of the Microbe-Plant interactions
CO-4. Learn the concept of plant pathology

B.Sc. Microbiology (Honours) Semester-5	
CORE CODE	**Hours**
MB11460: Soil and Agricultural Microbiology	**2 Hours /week**
Topic	**Hours**
UNIT-I Soil Microbiology	
1.1 Physico-chemical properties of Soil & Soil Structure 1.2 Microbial Flora of Soil & Soil as microbial habitat 1.3 Factors affecting microbial community in soil 1.4 Microbial biomass as an index of soil fertility 1.5 Soil fertility	09
UNIT-II Agricultural microbiology	
2.1 Production of bacterial biofertilizer 2.2 Algal and other related biofertilizers 2.3 Endophytic nitrogen fixers 2.4 Mycorrhizal biofertilizer 2.5 Biopesticide	06
UNIT-III Microbe-Plant interactions	
3.1 Phylosphere microorganisms 3.2 Rhizosphere and Rhizoplane microorganisms 3.3 Mycorrhizae 3.4 Nitrogen fixing bacteria associated with plant	08
UNIT-IV Plant pathology	
4.1 Concept of Disease in plant 4.2 Disease triangle and Stages of development of plant disease 4.3 Citrus canker 4.4 Tobacco mosaic disease 4.5 Black Stem rust of wheat 4.6 Red rot of sugar cane	07

Reference books:

1. Willey J., Sherwood I., (2011), Prescott, Harley and Kleins Microbiology, 9th ed., Mc Graw – Hill.
2. Dubey R. C and Maheshwari D. K., (2018), A Textbook of Microbiology. S. Chand and Company Ltd.
3. Agrios G. N. (2005), Plant Pathology. 5th Ed., Elsevier Academic Press

SEMESTER-5

MB11470: Medical Microbiology

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

Objectives of the course:

- ☞ Basic concepts of microbial pathogenicity and infection.
- ☞ Human Infections transmitted by contaminated Air, Food & Water, Close Contact and Vector.

Course outcome: after completion of the course, students will

CO-1. Understand basic concepts of Pathogenicity and Infection.
CO-2. Learn some of the Air-borne diseases (Respiratory tract infections)
CO-3. Learn some of the Food and Water-borne diseases (Gastro-intestinal infections)
CO-4. Learn some of the Contact & Vector-borne infections

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Pathogenicity and Infection	08	25
2.	Air-borne diseases (Respiratory tract infections)	07	25
3.	Food and Water-borne diseases (Gastro-intestinal infections)	08	25
4.	Contact & Vector-borne infections	07	25
	Total	**30**	**100**

B.Sc. Microbiology (Honours) Semester-5	
Subject	**Hours**
MB11470: Medical Microbiology	**2 Hours /week**
Topic	**Hours**
Unit-I: Pathogenicity And Infection	
1.1 Important terminologies 1.2 Course of infectious disease 1.3 Pathogenicity Island 1.4 Virulence factor 1.5 Exposure and Transmission	08
Unit-II: Air-Borne Diseases (Respiratory Tract Infections)	
2.1 Diphtheria 2.2 Tuberculosis 2.3 Pneumonia 2.4 Common cold 2.5 SARS & MERS 2.6 Influenza 2.7 Aspergillosis	07
Unit-III: Food And Water-Borne Diseases (Gastro-Intestinal Infections)	
3.1 Gastroenteritis: Bacterial & Viral 3.2 Salmonellosis & Typhoid 3.3 Cholera 3.4 Bacillary Dysentery 3.5 Amoebic Dysentery	08
Unit-IV: Contact & Vector-Borne Infections	
4.1 Staphylococcal Infection 4.2 Syphilis 4.3 AIDS 4.4 Malaria 4.5 Filaria 4.6 Dengue	07

Reference books:

1. Willey J., Sherwood I., (2011), Prescott, Harley and Kleins Microbiology, 9th ed., Mc Graw – Hill.
2. Pelczar, Chan and Krieg, (2001), Microbiology-Concepts and Application, 5th Ed.

3. Pommerville J. C., (2014), Alcamo's fundamentals of microbiology, 10th ed., Jones and Bartlett learning
4. Tortora G.J., and Funke B.R. (2016), Microbiology an Introduction, 12th Ed., Benjamin Cummings.
5. Madigan, T. M., & Martinko, J. M. (2008). Brock Biology of Microorganisms.
6. Black, J. G., (2014). Microbiology, 9th edition, Wiley, John Wiley and Sons., Inc
7. Nester E. W., Anderson D. G., Roberts C. E. and Nester M. T., (2009), Microbiology: A human perspective, 6th Ed., McGraw-Hill

MB11480: Industrial 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 skills in industrial microbiology. This course covers the principles of various aspects associated economics and recovery of different fermentation products.
- Also introduce students about the large-scale production of microbial products and microbial transformation which would facilitate the economic growth.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Downstream processing	08	25
2.	Fermentation economics	08	25
3.	Microbial biotransformation and enzyme technology	07	25
4.	Microbial production of industrial products	07	25
	Total	**30**	**100**

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

CO-5.	Understanding of purification achieved heightened precision, ensuring pharmaceuticals to meet severe quality standards and efficiency in industry.
CO-6.	Optimized resource utilization and scale-up strategies, driving down production costs and fostering greater accessibility to products and market competitiveness in industrial sectors
CO-7.	Unlocked novel pathways for efficient synthesis of valuable compounds, driving innovation across pharmaceuticals and agriculture. Also, to become aware of microbial enzymes technology.
CO-8.	Have acquired a detailed knowledge of the numbers of products which are produced by industrial fermentation processes.

B.Sc. Microbiology Semester-5		
CORE COURSE		Hours
MB11480: Industrial Microbiology		2 Hours /week
		Hours
Unit – I	**Downstream processing**	
1.1	Cell harvesting (Sedimentation, Centrifugation and Filtration)	08
1.2	Cell disruption (Mechanical and Non-mechanical cell disruption)	
1.3	Product recovery (Chromatography, Dialysis and electrodialysis)	
1.4	Distillation and Finishing steps (Crystallization and Drying)	
Unit – II	**Fermentation economics**	
2.1	Isolation, Strain improvement and Market potential	08
2.2	Plant and Equipment, Media, Air sterilization potential	
2.3	Heating and cooling, aeration and agitation, batch and Continues Culture potential	
2.4	Recovery cost, Water usage, recycling and Effluent treatment potential	
Unit – III	**Microbial biotransformation and enzyme technology**	
3.1	Introduction, Procedures and application of biotransformation	07
3.2	Transformation of steroids, sterols and nonsteroid compounds	
3.3	Transformation of antibiotics and pesticides	
3.4	Properties of Enzymes, Methods of Enzyme production, Immobilization of Enzymes	
Unit – IV	**Microbial production of industrial products**	
4.1	Antibiotics: Penicillin and Streptomycin	07
4.2	Enzymes: Amylase, Pectic and Cellulase	
4.3	Amino acids: L-Glutamate and L-Lysine	
4.4	Vitamin: Vitamin B_2 (Riboflavin) and Vitamin B_{12} (Cobalamin)	

Reference books:

1. Michael J. Waites, Neil L. Morgan, John S. Rockey and Gary Higton. (2001). Industrial Microbiology: An Introduction, 1st Ed., Blackwell Publishing.
2. Shivakumar, P. K., Joe, M. M. and Sukesh, K. (2010). An Introduction to Industrial Microbiology, 1st Ed., S Chand Publications.
3. Crueger, Wulf and Crueger Annneliese. (2005). Biotechnology: A textbook of Industrial Microbiology, 2nd Ed., Panima, New Delhi.
4. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall (2003). Principles of Fermentation Technology, 2nd Ed. Butterworth-Heinemann Publication.

5. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall (2016). Principles of Fermentation Technology, 3rd Ed. Butterworth-Heinemann Publication.
6. Dubey, R. C. (2010). Textbook of Biotechnology, 1st Ed., S. Chand, Multicolor.
7. Patel, A. H. (2012). Industrial Microbiology. 2nd Ed., Macmillan, India.

SEMESTER-5

MB11490: Microbiology Practical V

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 molecular biology, industrial microbiology, medical Microbiology, soil and agriculture microbiology, immunology and food microbiology.
- Also introduce students about the hands on practical knowledge on DNA, Fermentation process, Isolation and identification of microorganism in medical field, study of agricultural important microorganism and various technique for qualitative and quantitative analysis of food samples.

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

CO-1.	proficiently execute DNA extraction, Plasmid extraction and gel electrophoresis techniques, enabling molecular analysis of genetic material.
CO-2.	possess the skills to isolation and estimation of microbial fermentation to produce important compound for industrial production.
CO-3.	proficient in conducting microbiological analysis of food samples to ensure safety and quality standards.
CO-4.	Expert in assessing soil microbial diversity and utilizing microbial-based strategies to enhance soil fertility and plant health.
CO-5.	demonstrate proficiency in identifying and characterizing pathogenic microorganisms using various diagnostic methods.
CO-6.	exhibit proficiency in performing immunological assays and analyzing immune responses.

Practical Code	MICROBIOLOGY PRACTICAL – V
1	Isolation and screening of amylase and cellulase producing microorganisms from soil.
2	Fermentative production of amylase and its estimation.
3	Ethanol fermentation and estimation from fruit waste material.
4	Purification of fermented product (ethanol) by distillation. (Demonstration)

5	Isolation of Bacterial genomic DNA
6	Isolation of Bacterial plasmid
7	Resolution and visualization of agarose gel electrophoresis
8	Microbiological analysis of food
9	Isolation and identification of any foodborne bacteria from food products
10	Preparation of Yogurt/Dahi/Sauerkraut
11	Isolation of Rhizobium from plant root nodules.
12	Isolation of Azotobacter from farm soil sample.
13	Isolation and study of Actinomycetes from soil.
14	Screening for phosphate solubilizing microorganisms from soil.
15	Isolation of plant pathogenic bacteria from citrus canker
16	Study of various stages of malarial parasites in peripheral blood smear by permanent mount.
17	Study of permanent slide for identification of filarial parasite.
18	Demonstration of Immuno-electrophoresis.
19	Widal test – Dreyer's Double Dilution
20	RPR test – Qualitative

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 -5
Department Specific Course (DSC)

MB14160: Quality Assurance and IPR

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

Objectives of the course:

This course is designed to train students in the theoretical and practical consideration of the management of microbiological quality assurance. Topics to be covered include, quality assurance in the microbiology. Invension translated into paten, process of protection of any novel invasion procedure, guideline and law could be understand using this topic

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Quality Assurance in Microbiology	08	25
2.	Microbial food Safety	07	25
3.	Introduction of IPR	08	25
4.	Patent Licensing and Agreement	07	25
	Total	**30**	**100**

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

CO-1. Develop a good knowledge of about quality control and quality assurance
CO-2. Understand the microbial analysis techniques of the product
CO-3. IPR law and patent filling procedure would be understand using topic

B.Sc. Microbiology Semester- 5		
DSC		**Hours**
MB14160: Quality Assurance and IPR		**2 Hours /week**
		Hours
Unit – I	Quality Assurance in Microbiology	
1.1 Quality control in Microbiology 1.2 Media sterility, Sanitation in laboratory 1.2.1 Quality control of product 1.2.2 Quality assurance of product 1.3 Good Laboratory Practice (GLP), Good Manufacturing Practice (GMP),		08
Unit – II	Microbial food Safety	
2,1 Introduction to food microbiology and food safety 2.2Microbiological examination of food 2.3 Advances in isolation and enumeration of microorganisms in food 2.4 Quality of Food and microbial safety,		07
Unit – III	Introduction of IPR	
3.1 Introduction to patent, Types of Patents 3.1.1 Patent Office and Authorities, Grant of Patent, Right and Obligation of a Patentee 3.1.2 Infringement of Patents, Offenses and penalties, Patents and other commercial Law, Patents International Law 3.2 Filling procedure of Indian Patent 3.3 Patent litigation, Trade Mark, copy right and Logo		08
Unit – IV	Patent Licensing and Agreement	
4.1 Patentable and non-patentable inversion 4.2 Patent Search Report, PCT 4.3 Renewal of patent, Patent licensing and agreement		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

5. Rajkumar S. Adukia HANDBOOK ON INTELLECTUAL PROPERTY RIGHTS IN INDIA 2007

Practical DSC- MB14170 (Quality Assurance and IPR)

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 basic concepts related to IPR, Grant of Patent and Patenting Authorities, brief idea about quality assurance process.

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

CO-1.	proficient in implementing quality assurance measures to ensure product consistency and regulatory compliance in diverse industries. They will also demonstrate understanding of intellectual property rights (IPR) concepts and strategies for protecting innovations and inventions.

Practical Code	Practical DSC (Quality Assurance and IPR)
1	Study of components and design of a BSL-III laboratory
2	Filing applications for approval from biosafety committee
3	Filing primary applications for patents
4	Study of steps of a patenting process
5	A case study of patent infringement.

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.

SEMESTER 5

DSC

MB14180: Fundamentals of Molecular Diagnostics

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

Objectives of the course:

- To make students aware of various current molecular techniques used for diagnosis of disease conditions
- Students after learning this can also opt for or expand their currier in the field of diagnostic techniques.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Nucleic acid based diagnostics**	08	25
2.	**Protein based diagnostics**	07	25
3.	**Advanced Diagnostic Techniques – I**	08	25
4.	**Advanced Diagnostic Techniques – II**	07	25
	Total	**30**	**100**

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

CO-1. Learn use various nucleic acid based, protein based and other advanced diagnostic techniques to detect diseased conditions
CO-2. Understand judge how these methods are applied in current research and diagnostics.
CO-3. Evaluate merits and demerits of the methods.
CO-4. Rationalize appropriate molecular methods for a given application.

B.Sc. Microbiology Semester-5		
DSC		Hours
MB14180: Fundamentals of Molecular Diagnostics		2 Hours /week
		Hours
Unit – I	Nucleic acid based diagnostics	
1.1	Principle and applications of molecular diagnostic tests	08
1.2	Nucleic acid based diagnostics	
	1.2.1 Types of nucleic acids and Target pathogens/ diseases	
	1.2.2 PCR, DNA and RNA Hybridization assays	
	1.2.3 Nucleic acid sequencing and NGS approaches in diagnostics	
Unit – II	Protein based diagnostics	
2.1	SDS- PAGE	07
2.2	Western Blot	
2.3	Dot Blot	
2.4	ELISA	
Unit – III	Advanced Diagnostic Techniques – I	
3.1	Sero-diagnostics : Methods, importance and applications	08
3.2	DNA array technology : principle, methods/types, applications	
3.3	Protein array/tissue array- principle, methods, applications	
Unit – IV	Advanced Diagnostic Techniques – II	
4.1	Biosensors - Principles, methods/types and applications in Microbiology	07
4.2	Nanotechnology - Principles, methods/types and applications in Microbiology	
4.3	Development and validation of diagnostic tests	
4.4	QA and QC in Molecular laboratory	

Reference books:

1. Biotechnology: Expanding horizons. B.D Singh.
2. A textbook of Biotechnology, R.C Dubey
3. Biotechnology by U Satyanarayan.
4. Debnath M, Prasad GBKS & Bisen PS. 2010. Molecular Diagnostics: Promises and Possibilities. Springer Science & Business Media

5. Molecular diagnostics: fundamentals, methods and clinical applications. Buckingham, Lela. FA Davis, 2019.

Practical DSC- MB14190 (Fundamentals of Molecular Diagnostics)

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 Fundamentals of Molecular Diagnostics.

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

CO-1.	adeptly apply molecular diagnostic techniques for pathogen detection and genetic screening, ensuring accurate and timely diagnosis of diseases. They will also demonstrate competence in interpreting molecular diagnostic results and implementing quality control measures to ensure assay reliability.

Practical Code	Practical DSC (Fundamentals of Molecular Diagnostics)
1	Preparations of buffers and reagents
2	Demonstration of PCR
3	ELISA for animal disease diagnosis
4	Extraction of DNA from the clinical specimens

SEMESTER-5

(DSC)
MB14200: Hematology & Hemostasis

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 Hematology & Hemostasis. This course covers the principles of various aspects associated with the hematological and hemostatic procedures.
- It also introduces students about the importance of hematological and hemostasis procedures in clinical aspects.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Introduction to Hematology**	08	25
2.	**Haematological Disorders**	07	25
3.	**Hemostasis & Hemostatic disorders**	08	25
4.	**Routine & Special hematological tests**	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 hematology and hemostasis.
CO-2. Understand the characteristics of various hematological and hemostasis procedures with their clinical significance.
CO-3. Gain knowledge regarding different fields and scope of Hematology and Hemostasis
CO-4. Perform basic experiments to study hematological & hemostatic disorders.

B.Sc. Microbiology Semester-5		
DSC		Hours
MB14200: Hematology & Hemostasis		2 Hours /week
		Hours
Unit – I	Introduction to Hematology	
1.1	Introduction & Hematopoietic system of human body.	08
1.2	Structure, Functions & Components of Blood.	
1.3	Synthesis of Hemoglobin, iron metabolism, hemoglobin variants & derivatives.	
1.4	Collection & processing of blood, types of anticoagulants and their uses	
Unit – II	Haematological Disorders	
1.1	RBC Indices: Normal, abnormal values, and Physiological variations	07
1.2	Anemia: Definition and classification of anemia; factor causing anemia, various types of anemia.	
1.3	Haemoglobinopathies: Thalassemia & Sickle Cell Anemia.	
1.4	Leukemia: Classification, various types of Leukemia and Polycythemia vera.	
Unit – III	Hemostasis & Hemostatic disorders	
1.1	Mechanism of physiologic hemostasis	08
1.2	Mechanism of hemostasis (Blood coagulation)	
1.3	The hemorrhagic disorders related to platelet and capillary defects	
1.4	Congenital deficiencies of hemostatic factors, Other clinical conditions affecting hemostasis	
Unit – IV	Routine & Special hematological tests	
1.1	Complete blood count (CBC) by manual and automatic method.	07
1.2	Estimation of hemoglobin by different manual and automated methods.	
1.3	Hematological test: Detection of Anemia & Leukemia.	
1.4	Estimation methods for bleeding disorders.	
1.5	Determination of: Iron, TIBC, malarial parasite, foetal hemoglobin etc.	

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

SEMESTER-5

MB14210: Practical DSC (Hematology & Hemostasis)

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 Hematology & Hemostasis.
- ☞ Also introduce students about the hands-on practical knowledge on Blood, Blood collection, study of blood component and handling of blood analysis instruments.

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

CO-1.	demonstrate proficiency in performing hematological analyses, including blood cell counts and morphology assessments. They will also exhibit competence in evaluating hemostatic mechanisms and interpreting coagulation profiles for diagnosis and treatment purposes.

Practical Code	Practical DSC (Hematology & Hemostasis)
1	Venous blood collection.
2	Estimation of hemoglobin by Cyanmethemoglobin estimation
3	Total RBC and WBC count
4	Differential WBC count
5	Determination of erythrocyte sedimentation rate (ESR)
6	Detection of Sickle Cell Anemia: Solubility, Sickling test
7	Bleeding Time (BT), Clotting Time (CT) and Prothrombin Time (PT)
8	Determination of erythrocyte indices using histogram from automated hematological analyser (demonstration)

SEMESTER-5

DSC

MB14220: Introduction to Nanobiotechnology

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

Objectives of the course:

- ☞ To sensitize about nanoscience with a specific focus on nanomaterials and their applications.
- ☞ To equip students with knowledge of the properties, synthesis methods, and applications of various nanostructured materials.
- ☞ To inform their impact on fields such as medicine, electronics, & environmental science.

Outline of the Course:

No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	**Introduction to nanoworld**	08	25
2.	**Preparation of nanomaterial**	08	25
3.	**Biofunctionalization of nanomaterial**	07	25
4.	**Applications of nanomaterial**	07	25
	Total	**30**	**100**

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

CO-1. Understand Fundamental of Nanoscience and Nanotechnology.
CO-2. Explore practical applications of nanotechnology in areas such as biosensors, drug delivery, medical diagnostics, implants, prostheses, tissue engineering, and environmental science.
CO-3. Learn about the construction of nanomachines, biomolecular structure, self-assembly, molecular recognition, and the challenges in designing nano bio-machines.
CO-4. Understand the area of applications

B.Sc. Microbiology Semester-5	
DSC	**Hours**
MB14220: Introduction to Nanobiotechnology	**2 Hours /week**
	Hours
Unit – I **Introduction to nanoworld**	
1.1 Introduction to nanomaterials, Properties of materials & nanomaterials; Information-driven Nano-assembly, Energetics, top down and bottom-up approach for building nanomaterials, Chemical Transformation Biomaterials, Machine-Phase Nanobiotechnology 1.2 Effect of size on properties of nanomaterial 1.3 Information-driven Nano-assembly, Energetics, top down and bottom-up approach for building nanomaterials, Chemical Transformation Biomaterials, Machine-Phase Nanobiotechnology	08
Unit – II **Preparation of nanomaterial**	
2.1 Introductory overview: preparation, characterization, and properties of nanostructured materials (e.g., metal nanoparticle, quantum dot, carbon nanotube, polymeric nanocarrier, and silica nanoparticle); 2.2 Chemical Routes for Synthesis of Nanomaterials 2.3 Fabrication of Nanomaterials by Physical Methods 2.4 Nanolithography and nanomanipulation	08
Unit – III **Biofunctionalization of nanomaterial**	
3.1 Biofunctionalization of nanomaterials (e.g., cell, nucleic acid, and protein); applications of biofunctionalized nanomaterials (e.g., diagnostics and screening technologies); 3.2 Structural Principles of Nanobiotechnology Construction of Nanomachines, The Raw Materials: Biomolecular Structure and Stability, Protein Folding, Self-Assembly, Self-Organization, Molecular Recognition, Atomicity limits the tolerance of combining sites, Flexibility, Flexibility poses great challenges for the design of nanobiomachine 3.3 DNA Templated Electronics, Sequence –specific molecular lithography, Single Biomolecule Manipulation for Bioelectronics, DNA as a semiconductor. 3.4 Applications in implants, prostheses, and tissue engineering; DNA nanostructures and DNA templated electronics; toxicity, health, and environmental issues	07
Unit – IV **Applications of nanomaterial**	
4.1 separation of cells and cell organelles; 4.2 Biosensors, Functionalization of Sensing Substrates, Biochip, Nanosensor-Miniaturization of Biosensors, Nanomaterial Based Biosensors, Nanoparticle-Biomaterial Hybrid Systems for Sensing and Electronic Devices, Effect of Biosensor in biological and physicochemical techniques; 4.3 Medical diagnostics: drug targeting, drug delivery, nano surgery and other biomedical field.	07

Reference books:

1. Wilson, M., Kannangara, K., Smith, G., Simmons, M. and Raguse, B., Nanotechnology: Basic Science andEmerging Technologies, Chapman & Hall/CRC, 2002
2. Niemeyer, C.M. and Mirkin, C.A., Nanobiotechnology: Concepts, Applications, and Perspectives, John Wiley & Sons, 2004.
3. Malsch, N.H., Biomedical Nanotechnology, Taylor & Francis, 2005.
4. Stroscio, M. and Dutta, M., Biological Nanostructures and Applications of Nanostructures in Biology:Electrical, Mechanical, and Optical Properties, Springer, 2004.
5. Kumar, C.S.S.R., Biofunctionalization of Nanomaterials, John Wiley & Sons, 2006.
6. Poole, C.P. and Owens, F.J., Introduction to Nanotechnology, John Wiley & Sons, 2003

Practical DSC MB14230 (Introduction to Nanobiotechnology)

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 nanotechnological system.

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

CO-1.	possess the skills to design and manipulate nanomaterials for various applications in medicine, electronics, and environmental remediation. They will also demonstrate proficiency in utilizing nanotechnology tools and techniques to address contemporary scientific and technological challenges.

Practical Code	Practical DSC (Introduction to Nanotechnology)
1	Coprecipitation method to prepare magnetic nanoparticles
2	Isolation of magnetotactic bacteria
3	Preparation and tracking of silver nanoparticles using bacteria
4	Antimicrobial activity of silver nanoparticles
5	Degradation/decolorization of dye using silver nanoparticles