Program Structure

Program: M.Sc. Biotechnology

Program Code: SBR0413

Batch: 2020-22

Department of Life Sciences

School of Basic Science & Research

M.Sc.

in

Biotechnology

COURSE STRUCTURE &SYLLABI

(For Batch 2020-21 onwards)

Department of Life Science
School of Basics Sciences and Research
SHARDA UNIVERSITY

Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

Vision and Mission of the School

Vision of the School

Achieving excellence in the realm of basic and applied sciences to address the global challenges of evolving society

Mission of the School

1. **To equip the students with knowledge and skills in basic and applied sciences**
2. **Capacity building through advanced training and academic flexibility.**
3. **To establish centre of excellence for ecologically and socially innovative research.**
4. **To strengthen interinstitutional and industrial collaboration for skill development and global employability.**

Vision and Mission of Department of Life Sciences

Vision of Life Sciences Department

Strive to achieve excellence in teaching and research in the field of Microbiology and Biotechnology and to build human resource for solving contemporary problems.

Mission of Life Sciences Department

- **Providing distinctive and relevant education in Life Sciences to students.**
- **Motivating young minds through innovative teaching methods, to acquire theoretical knowledge and practical skills in different disciplines of chemistry and empowering them with problem solving skills.**
- **Nurturing innovation by carrying out world class research and scholarly work**
- **Promoting interdisciplinary research in collaboration with national/international laboratories/Institutions.**

Program Educational Objectives (PEO)

PEO1: To create a foundation of various biological concepts and phenomena in the minds of students through theoretical and practical knowledge.

PEO2: To keep students upgraded with new discoveries in biological world and inculcate continuous learning and self-improvement so that students are motivated for higher studies and research.

PEO3: To teach the students various bio-techniques and application of these techniques for betterment of society and environment.

PEO4: To make students industry- or academia-ready by developing independent thinking, good communication and scientific skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.

PEO5: To make students understand interdisciplinary nature of research in biotechnology by assigning them different research projects/ case studies/ presentations.

Map PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1	3	2	-	-
PEO2	3	2	2	-
PEO3	3	3	2	1
PEO4	2	3	2	2
PEO5	3	2	2	2

1. **Slight (Low) 2. Moderate (Medium) 3. Substantial (High)**

Map PEOs with Department Mission Statements:

PEO Statements	Departmental Mission 1	Departmental Mission 2	Departmental Mission 3	Departmental Mission 4
PEO1	3	1	1	1
PEO2	3	3	2	2
PEO3	2	2	2	2
PEO4	3	-	2	3
PEO5	3	2	3	2

Program Outcomes (PO's)

PO1: Knowledge: Students will develop a sound understanding the biological systems and processes.

PO2: Skill Set Development: The student will be skilled in various biological techniques that will enhance the employability of the students.

PO3: Oral Communication and Scientific Writing: The students will be able to demonstrate good oral communication. Students will also be knowledgeable about writing technical (project report and reviews) content.

PO4: Environment and Sustainable Development: Student will be able to realize the effect of human malpractices on environment and the need and importance of sustainable development.

PO5: Ethics, Independent Thinking and Team Work: The students will develop professional ethics and also gain knowledge about various ethical issues associated with biotechnology.

Students will learn to think and analyze a problem independently while at the same time realizing the importance of team work in carrying out successful research/ projects/ presentations.

Mapping of Program Outcome Vs Program Educational Objectives

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	2	2	2
PO2	3	2	2	3	2
PO3	1	1	-	3	2
PO4	1	2	3	-	2
PO5	1	2	-	3	2

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

SUMMARY SHEET

Teaching Department	**:**	Life Science
School	**:**	School of Basic Sciences and Research
Name of Course	**:**	M.Sc. in Biotechnology
Duration	**:**	Two Years
Total number of Credits	**:**	90

Term I

SN	Subject Code	Subjects	Teaching Load			Credits
			L	T	P	
THEORY SUBJECTS						
1.	MSB114	Advanced Biochemistry	4	0	0	4
2.	MSB122	Advanced Molecular Biology	4	0	0	4
3.	MSB202	Medical Biotechnology	4	0	0	4
4.	MSB206	Enzyme Technology	4	0	0	4
5.	MSB124	IPR	4	0	0	4
Practical/Viva-Voce/Jury						
6.	MSP206	Enzyme Technology Lab	0	0	3	2
7.	MSB155	Biochemistry Lab	0	0	3	2
8.	MSB156	Molecular Biology Lab	0	0	3	2
TOTAL CREDITS						**26**

Term II

S. No.	Subject Code	Subjects	Teaching Load			Credits
			L	T	P	
THEORY SUBJECTS						
1.	MSB116	Bio instruments	4	0	0	4
2.	MSB118	Advances in Plant Biotechnology	4	0	0	4
3.	MSB123	Advanced Genetic Engineering	4	0	0	4
4.	MSB119	Animal Cell Technology	4	0	0	4
5.	MSB125	Bioinformatics	4	0	0	4
Practical/Viva-Voce/Jury						
6.	MSB159	Genetic Engineering Lab	0	0	3	2
7.	MSB158	Plant Biotechnology Lab	0	0	3	2
8.	MSB160	Bioinstrumentation Lab	0	0	3	2
TOTAL CREDITS						**26**

Term III

S. No.	Subject Code	Subjects	Teaching Load			Credits
			L	T	P	
THEORY SUBJECTS						
1	MMB201	Environment Microbiology and waste management	4	0	0	4
2	MSB204	Genomics	4	0	0	4
3	MSB207 /MSB117	Microbial Biotechnology / Immunology and Immunotechnology	4	0	0	4
4	MSB209	Bioprocess technology and Quality Control	4	0	0	4
5	MSB208	Cancer Biology	2	0	0	2
Practical/Viva-Voce/Jury						
6.	MSB256	Genomics & Bacterial Genetics Lab	0	0	3	2
7.	MSB259 /MSB157	Microbial Biotech Lab /Immunotechnology Lab	0	0	3	2
8.	MSB260	Bioprocess technology Lab	0	0	3	2
9.	CCU401	Community Connect	0	0	2	2
TOTAL CREDITS						**26**

Term IV

Practical/Viva-Voce/Jury						
1.	MSB261	Project / Dissertation / Industrial Training	0	0	18	12
TOTAL CREDITS						12

MSB114 : Advanced Biochemistry
L-T-P: 4-0-0 Credits 4

School : SBSR		**Batch : 2020-2022**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	**MSB114**	
2	Course Title	**Advanced Biochemistry**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
6	Course Objective	1. Structure of polysaccharides 2. Classification and structure of lipids 3. Protein-ligand interaction and modulation of protein activity 4. Assimilation of inorganic phosphorus, sulfur and nitrogen, Nitrogen fixation	
7	Course Outcomes	After studying this course, students will be able to CO1: Determine Classification and structure of carbohydrates CO2: Evaluate Nucleic acid structure, nucleic acid chemistry, Functions of Nucleotides CO3: Interpret the Protein-ligand interaction and modulation of protein activity CO4: Analyse the Biosynthesis of polysaccharides and interconversion of sugars CO5: Determine Synthesis of purines, pyrimidines and nucleotides CO6 : Analyze and study Photosynthesis and photophosphorylation	
8	Course Description	This course contains various advanced biochemistry concepts ranging from structure and classification of carbohydrates, proteins, nucleic acids and nucleotides. After studying course, students will be able to learn chemistry of biomolecules, and their metabolic pathways.	
9	Outline syllabus		CO Mapping
	Unit 1	**Carbohydrates**	**CO1**
	A	Classification and structure of carbohydrates, Structure of polysaccharides	
	B	glycoproteins and peptidoglycans, Functions of polysaccharides	
	C	glycoproteins and peptidoglycans.	
	Unit 2	**Lipids Amino acids, Nucleic acids and Nucleotides**	**CO2**
	A	Classification and structure of lipids, Saturated and unsaturated fatty acids, rancidity	
	B	Classification, structure and functions of amino acids, Peptide Bond, Ramachandran Plot, Primary, secondary and Tertiary structure of Proteins	
	C	Nucleic acid structure, nucleic acid chemistry, Functions of Nucleotides	
	Unit 3	**Chemistry of Biomolecules, Biological Membranes and Transport**	**CO3**
	A	Protein-ligand interaction and modulation of protein activity, protein sequencing	

	B	Composition and architecture of membranes			
	C	membrane dynamics, solute transport across membranes			
	Unit 4	**Metabolic Pathways**			**CO4**
	A	Glycolysis, Entner-Doudoroff, HMP and oxidative pentose phosphate;Glyoxylate cycle, TCA cycle, and oxidative phosphorylation,			
	B	Biosynthesis of polysaccharides and interconversion of sugars **Catabolism:** Bioenergetics of β-oxidation of fatty acids,			
	C	long chain fatty acids, Anabolism: **Biosynthesis of fatty acids:** saturated, unsaturated			
	Unit 5	**Nucleotide Biosynthesis and Use of Energy in Biosynthesis**			**CO5**
	A	Synthesis of purines, pyrimidines and nucleotides			
	B	Photosynthesis and photophosphorylation, Photorespiration			
	C	Assimilation of inorganic phosphorus, sulfur and nitrogen, Nitrogen fixation			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Nelson D.L. and Cox M.M., "Lehninger Principles of Biochemistry", W.H. Freeman, 2009			
	Other References	Stryer L., "Biochemistry", W. H. Freeman, 2010. Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2005.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	1	1	1	1	1

MSB122: Advanced Molecular Biology

L-T-P:4-0-0 Credits 4

School: SBSR		**Batch: 2020-2022**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 01**	
1	Course Code	**MSB122**	
2	Course Title	**Advanced Molecular Biology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	**Compulsory**/Elective/Open Elective	
5	Course Objective	1. Understand the structure and function of nucleic acids and genome organization. 2. Understand the process of DNA replication and Transcription in prokaryote and eukaryote. 3. Understand the process of Translation and regulation of gene expression.	
6	Course Outcomes	CO1: To understand the structure and function of Nucleic acid, Chromatin and Chromosome. CO2: To understand the process of DNA replication in prokaryotes and eukaryotes. CO3: To understand the process of transcription in prokaryotes. CO4: To understand the process of transcription in eukaryotes. CO5: To understand the process of Translation and regulation of gene expression CO6: Observe different life processes happening at molecular level inside cell and perspectives on gene regulation.	
7	Course Description	The course covers the gene organization in prokaryotic and eukaryotic cells. Course will familiarise students with the process of replication, transcription, post-transcriptional modifications and translation in both prokaryotes and eukaryotes.	
8	Outline syllabus		CO Mapping
	Unit 1	**Genome Organization**	
	A	Structure of DNA and RNA, Nucleoside and nucleotide, complementary base pairing	CO1
	B	DNA melting and reassociation kinetics	CO1
	C	Structure of eukaryotic chromosomes, Euchromatin and heterochromatin.	CO1
	Unit 2	**DNA Replication**	
	A	Replication process in prokaryotes	CO2
	B	Replication process in eukaryotes	CO2

	C	Enzymes and accessory proteins in replication, Replication of ss-circular DNA			CO2
	Unit 3	**Prokaryotic Transcription**			
	A	Process of prokaryotic transcription			CO3
	B	Inducible and constitutive promoters			CO3
	C	Operators and regulators in prokaryotic transcription			CO3
	Unit 4	**Eukaryotic Transcription**			
	A	Process of eukaryotic transcription			CO4
	B	Eukaryotic promoters and enhancers, TATA binding proteins and associated factors, activators and repressors			CO4
	C	Post-transcriptional modifications			CO4
	Unit 5	**Translation and Regulation of gene expression**			
	A	Translation machinery, Ribosome, degeneracy of codons and termination codons			CO5
	B	Mechanism of initiation, elongation and termination			CO5
	C	Operon system, Lac operon, Trp operon and Ara operon.			CO5
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Lewin B., "Gene IX", Jones and Barlett Publishers, 2007			
	Other References	1. Alberts B., Johnson A., Lewis J. and Raff M., "Molecular Biology of the Cell", Garland Science, 2002. 2. Watson J.D., Hopkins N.H., Roberts J.W., Seitz J.A. and Weiner A.M., "Molecular Biology of the Gene", Benjamin Cummings Publishing Company Inc, 2007			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB202: Medical Biotechnology

L-T-P: 4-0-0 Credits 4

School: SBSR		**Batch : 2020-2022**	
Program: MSc		**Current Academic Year: 2020-21**	
Branch: BT		**Semester: 01**	
1	Course Code	**MSB202**	
2	Course Title	**MEDICAL BIOTECHNOLOGY**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	**Compulsory**	
5	Course Objective	1.Students will be able to understand complete mechanism of infection, diseases transmission and host parasite relationship. 2.Correlate between emerging and resurgent infectious diseases and the importance of new therapeutic strategies. 3.Evaluate the efficacy of different chemicals and antimicrobial drugs and determine the mechanism of resistance to antibiotics 4.Students will understand concept of vaccines and new strategies that can be used for vaccine development.	
6	Course Outcomes	CO1: Describe different types of microbial infections and causative agents CO2: Classify different pathogenic organisms based on nucleic acid properties CO3: Comprehend concepts of sterilization, anti-bacterial, anti-fungal and anti-viral vaccines and drugs. CO4: Assess the methods of prevention of infection, and the basic concepts of identification of causative agents CO5: Describe the advanced methods of diagnostics of infectious diseases and cancer CO6: Compare the different causes of infection, their methods of detection, prevention and therapy	
7	Course Description	Medical Biotechnology course is to develop the concept of host parasite relationship, epidemiology of different diseases. To understand the mode of action of different antimicrobial drugs and chemicals. To understand the treatment mechanism of different bacterial, viral and fungal pathogens.	
8	Outline syllabus		CO Mapping
	Unit 1	**Microbial diseases**	CO1, CO6
	A	Bacteria: Representative diseases to be studied in detail - tetanus, diphtheria, cholera, typhoid. Infections caused by anaerobic bacteria: chlamydia, rickettsiae.	

	B	Viruses: Representative diseases to be studied in detail are - viral hepatitis, influenza, rabies, polio and AIDS.	
	C	Fungi: Diseases to be taken up in following categories: superficial, subcutaneous, systemic and opportunistic mycoses. Protozoa: Diseases to be discussed are - amoebiasis, toxoplasmosis, trichomoniasis & leishmaniasis	
	Unit 2	**Epidemiology, microbial assays, microbial DNA replication**	CO2, CO6
	A	Disease burden: microbial, viral, fungal and parasitic. Investigation of epidemics	
	B	Methods of culturing and assaying: bacterial, viral and parasitic.	
	C	Classification: fungal, protozoal, helminthic, bacterial and viral replication of DNA, RNA+ve and RNA-ve viruses, retroviruses	
	Unit 3	**Vaccines, drugs and therapy**	CO3, CO6
	A	Sterilization techniques: biohazard hoods; containment facilities, BSL 2, 3, 4; Bacterial and viral vectors; Biological warfare agents	
	B	Mode of action of antibiotics and antiviral: molecular mechanism of drug resistance (MDR)	
	C	Viral vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins; Anti-viral chemotherapy. Anti-fungal chemotherapy	
	Unit 4	**Nosocomial infections, prevention of infection, basics of diagnostic approaches**	CO4, CO6
	A	Hospital-acquired infections (nosocomial), immune compromised states	
	B	Water and waste management for water-borne diseases	
	C	Modern approaches for diagnosis of infectious diseases: Basic concepts of gene probes, dot hybridization and PCR assays	
	Unit 5	**Advanced diagnostic techniques**	CO5, CO6
	A	DNA diagnostics: PCR based diagnostics; ligation chain reaction, southern blot diagnostics, array-based diagnostics. G-banding, in situ hybridization (FISH and on-FISH), and comparative genomic hybridization (CGH).	
	B	Cancer cytogenetics: spectral karyotyping. Immunodiagnostics: diagnosis of infectious diseases, respiratory diseases (influenza, etc.)Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases and mycobacterium diseases.	
	C	Phage display, immunoarrays, FACs.	

	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Willey J., Sherwood L., Woolverton C., "Prescott's Microbiology", McGraw-Hill, 2010.			
	Other References	1. Collier L., Balows A., Sussman M., "Topley and Wilson's Text Book on principles of Bacteriology, Virology and Immunology", Holder Education Publication, 1998. 2. Black J.G., "Microbiology: Principles and Explorations", Wiley, 2012. 3. Pongracz J., Keen M., "Medical Biotechnology", Elsevier Health Sciences, 2009.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	2	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	2	3
CO6	3	3	3	3	3

MSB206: Enzyme Technology

L-T-P: 4-0-0 **Credits 4**

School: SBSR		**Batch: 2020 – 22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	**MSB206**	
2	Course Title	**Enzyme Technology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	With this Course the students 1. will acquire knowledge fundamental Knowledge of Enzymes 2. Will get useful exploitation of enzymes physical and kinetic properties 3. Use Enzymes biocatalysts in the biotransformation 4. Know the Industrial, Research and Therapeutic applications of Enzymes	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1. Define and Classify Enzymes and its fundamentals properties CO2. Examine Enzyme Kinetics, Perform and calculate enzyme specificity and activity CO3. Evaluate Enzyme Inhibition and its types, Competitive and Non-competitive inhibition and its significance CO4. Understand Allosteric Enzymes regulation, Covalent modification, Determine the role of co-enzymes, Enzyme constitution and immobilization CO5. Evaluate Applications of Enzymes in industry, Enzymes in clinical diagnostics. sensors for clinical processes and environmental, Microbial analyses, Engineered Enzymes. CO6. To analyse Enzymes principles, properties, Kinetics, Inhibition, Allosterism, Co-Enzymes, Engineered Enzymes, Application of Enzymes in various industries, research and therapeutic aspects	
7	Course Description	This course covers fundamentals to applications necessary for the useful exploitation of enzymes both as tools for the enzymatic analyses and as biocatalysts in the biotransformation on the unique structural-functional properties of enzymes and its microbial industrial and research utilization.	
8	Outline syllabus		CO Mapping
	Unit 1	**Properties of Enzymes**	CO1,6
	A	Classification of enzymes, Structural conformations of enzyme proteins	CO1,6
	B	Enzymes as biocatalysts, Catalytic power, Activation energy	CO1,6

	C	Substrate specificity, Mechanisms of enzyme action, Ribozymes and abzymes			CO1,6
	Unit 2	**Enzyme Kinetics**			CO2,6
	A	Factors affecting rates of enzymatic reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time)			CO2,6
	B	Overview of Michaelis-Menten equation and its transformation, Lineweaver-Burke plot			CO2,6
	C	Evaluation of kinetic parameters (K_M, V_{max})			CO2,6
	Unit 3	**Enzyme Inhibition**			CO3,6
	A	Irreversible and reversible inhibition			CO3,6
	B	Competitive, non-competitive and un-competitive inhibition			CO3,6
	C	Enzyme inhibition kinetic studies, Determination of k_{cat}.			CO3,6
	Unit 4	**Regulation of Enzyme Activity**			CO4,6
	A	Allosterism, Kinetic analysis of allosteric enzymes			CO4,6
	B	Covalent modification, Feed-back inhibition, Membrane bound enzymes			CO4,6
	C	Isoenzymes and marker enzymes, Constitutive and inducible enzymes			CO4,6
	Unit 5	**Applications of Microbial Enzymes**			CO5,6
	A	Microbial enzymes in textile, leather, wood industries and detergents			CO5,6
	B	Enzymes in clinical diagnostics and Enzyme sensors for clinical processes and environmental analyses			CO5,6
	C	Engineered enzymes, Enzymes as therapeutic agents			CO5,6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Palmer T., Bonner P. L., "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Woodhead Publishing, 2007.			
	Other References	1. Copeland R. A., "Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis", Wiley, 2006. 2. Guisán J. M., "Immobilization of Enzymes and Cells (Methods in Biotechnology)", Humana Press, 2010.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB124: Intellectual Property Rights

L-T-P: 4-0-0 Credit – 4

School : SBSR		**Batch : 2020– 22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	MSB124	
2	Course Title	**Intellectual Property Rights**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To elucidate the ways of protection of intellectual property and research with the help of WIPO and its different treaties. To correlate different instruments of IP protection and their enforcement in different countries. To understand different quality management issues related to biotechnology	
6	Course Outcomes	By the end of this course students will be able to: CO1: Administer and follow the guidelines of WIPO. CO2: Understand the patents, copyrights and trademarks. CO3: Understand the character merchandising and franchising. CO4: Understand the utility of IPRs in biotechnology. CO5: To correlate different instruments of IP protection and their enforcement in different countries. CO6: To elucidate the ways of protection of intellectual property and research with the help of WIPO and its different treaties.	
7	Course Description	*Intellectual property* (IP) includes intangible creations of the human intellect, and primarily encompasses copyrights, patents, and trademarks. It also includes other types of rights, such as trade secrets, publicity rights, moral rights, and rights against unfair competition. Present paper deals with knowledge of types and protection of different IPRs.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Intellectual Property Rights**	**CO1, CO4**
	A	The concept of intellectual property, Importance of IPR in biotechnology	
	B	WIPO- history, mission and activities, structure, administration.	
	C	Major International Instruments relating to the protection of IP; Berne Convention; Paris Convention; TRIPS	
	Unit 2	**Patents**	
	A	Patents-basic concepts; Non patentable inventions	CO2, CO3, CO4
	B	Procedure for registration , Term of patent , Rights of patentee	

	C	Patent Infringement and its remedy; Compulsory licenses and Government use of patent			
	Unit 3	**Copyrights**			CO2, CO3, CO4
	A	Copyright and related rights;			
	B	Copyright piracy and infringement; Remedies of copyright piracy and infringement			
	C	Copyright Issues in Digital Environment			
	Unit 4	**Trademarks**			CO2, CO3, CO4
	A	Definitions, Signs which serve as trademarks,			
	B	Trademark piracy, and counterfeiting; Character Merchandising.			
	C	Geographical Indication; Difference between GI and Trade Marks			
	Unit 5	**IPR in industries**			CO3, CO4
	A	IPR strategies by different industries; E-Commerce and IPR issues			
	B	Case studies of Major IPR conflicts: Zara Vs Zara fashions; Yahoo Vs Yahoo India.			
	C	Case studies of Major IPR conflicts: AMUL Vs IMUL; Paytm Vs PayPal			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Managing intellectual capital: organizational, strategic and policy dimensions Oxford Univ. press 2005 Teece, David J.			
	Other References	2. Techniques used in Bio product analysis, Butterworth Heinemann Ltd, 2017. 3. Law relating to patents, trademarks, copyright designs geographical indications. Universal Law Publishing house by Wadehra, B.L.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	2	1	3	1
CO5	1	1	1	1	3
CO6	3	1	1	1	1

MSP206: Enzyme Technology Lab

L-T-P: 0-0-3 Credits 2

School: SBSR		**Batch: 2020-22**			
Program: M.Sc.		**Current Academic Year: 2020-21**			
Branch: Biotechnology		**Semester: 01**			
1	Course Code	**MSP206**			
2	Course Title	**Enzyme Technology Lab**			
3	Credits	2			
4	Contact Hours (L-T-P)	0-0-3			
	Course Status	**Compulsory**/Elective			
5	Course Objective	To give students a thorough understanding of enzymes and enzyme kinetics. To make students learn the working and operation of enzymes as well as measurement of enzyme activity			
6	Course Outcomes	CO1: To understand the mode of action of salivary amylase CO2: Preparation of standard curve for calculation of enzyme activity. CO3: Assaying the activity of industrially important amylase enzyme using 3,5-Dinitrosalicylic acid method. CO4: To determine the pH optima of amylase enzyme CO5: To determine the temperature optima of amylase enzyme CO6: To give students a thorough understanding of enzymes and enzyme kinetics.			
7	Course Description	This course is designed to make students learn about enzymes, measurement of their activity in terms of IU and katal as well as understanding the kinetics of enzymes.			
8	Outline syllabus				CO Mapping
	Unit 1	**Salivary amylase**			CO1
		Mode of action of α-amylase on starch			CO1
	Unit 2	**Calculation of Enzyme Activity**			CO2
		Preparation of standard curve			CO2
	Unit 3	**Assaying the activity of industrially important amylase**			CO3
		3'5'- Dinitrosalicylic acid method			CO3
	Unit 4	**pH optima**			CO4
		To determine the pH optima of amylase enzyme			CO4
	Unit 5	**Temperature optima**			CO5
		To determine the temperature optima of amylase enzyme			CO5
	Mode of exam	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Textbook/s*	1. Palmer T., Bonner P. L., "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Woodhead Publishing, 2007.			
	Other References	2. Copeland R. A., "Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis", Wiley, 2006.			

		3. Guisán J. M., "Immobilization of Enzymes and Cells (Methods in Biotechnology)", Humana Press, 2010.

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	2
CO4	2	2	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB156: Molecular Biology Lab

L-T-P: 0-0-3 Credits 2

School : SBSR		**Batch : 2020 – 22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 01**	
1	Course Code	**MSB156**	
2	Course Title	**Molecular Biology Lab**	
3	Credits	2	
4	Contact H (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To familiarize students with sterilization techniques and solution/media preparations etc. 2. To motivate students towards molecular techniques for better genome understanding. 3. To acquaint with principles, technical requirement, scientific and commercial applications in molecular biology. 4. Design and manage techniques for understanding interplay amongst macromolecules.	
6	Course Outcomes	CO1: Demonstrate safe laboratory practices and handle the equipment safely. CO2: Estimate the quality and quantity of nucleic acids. CO3: Amalgamation of tools for plasmid vectors and DNA uptake. CO4: Perform *in silico* analysis for studying genome. CO5: To design primers and carry out amplification of DNA by PCR. CO6: Complete acquaintance with principles, technical requirement, scientific and commercial applications in molecular biology.	
7	Course Description	The aim of this course is to acquaint the students about the versatile tools and techniques employed in molecular biotechnology. The course will also provide students with a hands-on understanding of how modern DNA-sequencing technology, along with bioinformatics tools, can be used to discover genetic differences and understand molecular function.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on introduction to molecular biology lab**	**CO1**
	A	Good lab practices in molecular biology laboratory.	
	B & C	Preparation of standard solutions for molecular biology experiments	

	Unit 2	**Isolation of Nucleic acids and quantification**			**CO2**
	A	Isolation of DNA from bacteria			
	B	Isolation of RNA from bacteria			
	C	Gel electrophoresis			
	Unit 3	**Practical related to preparation of plasmids and transformations**			**CO3**
	A	Plasmid isolation			
	B	Preparation of competent cells			
	C	Transformation of plasmid into competent cells			
	Unit 4	**Practical related to in silico analysis of genome**			**CO4**
	A	Sequence similarity search with freely available tools			
	B	Construction of phylogenetic tree			
	C	Identification of motifs and domain in sequences			
	Unit 5	**Practical related to gene amplification**			**CO5**
	A & B	Designing of primers for CDs and partial sequences			
	C	Performing PCR reactions			
	Mode of examination	Practical and/or Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Textbook/s	Michael, R. G., Sambrook. J., "Molecular Cloning-A Laboratory Manual", 4th edition, Cold Spring Harbor Laboratory Press, 2012.			
	Other References	1. Davis, L. (2012). Basic methods in molecular biology. Elsevier. 2. Chard, T., Work, T. S., & Work, E. (1987). Laboratory techniques in biochemistry and molecular biology. Elsevier, Amsterdam.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB155: Biochemistry Lab

L-T-P: 0-0-3 Credits 2

School: SBSR		**Batch: 2020-2022**	
Program: M.Sc.		**Current Academic Year: 2020-2021**	
Branch: Biotechnology		**Semester: 01**	
1	Course Code	**MSB155**	
2	Course Title	**Biochemistry Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To understand difference between types of biomolecules 2. To learn qualitative estimation of biomolecules 3. To learn the separation techniques for various biomolecules 4. To understand the enzymatic parameters that indicate proper functioning of living systems	
6	Course Outcomes	After finishing the course, the students will be able to CO1: identify and distinguish between mono-, di-, and oligosaccharides present in different samples CO2: analyse individual compounds present in a particular mixture/ extract and explain different chromatographic techniques CO3: illustrate presence of starch and other plant secondary metabolites in leaf CO4: isolation and quantitation of DNA CO5: illustrate metabolite/ enzymatic markers for particular organs CO6: use biotechniques for identification, separation and or analysis of biomolecules and enzymatic markers in different samples	
7	Course Description	Biochemistry lab course is designed to make students learn the estimation of carbohydrates, lipids, proteins and nucleic acids. The students also learn various techniques such as various types of chromatography used for separation of amino acids and plant secondary metabolites, estimation of various plant secondary metabolites, estimation of biomarkers for hepatic and renal function etc.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on estimation of carbohydrates**	
		Subunit – a and b	CO1, CO6
	Unit 2	**Practical related to estimation and separation of amino acids**	
		Subunit – a and b	CO2, CO6
	Unit 3	**Practical related to estimation of starch**	
		Subunit - b and c	CO3, CO6
	Unit 4	**Practical related to isolation and estimation of nucleic acids**	

		Subunit - c			CO4, CO6
	Unit 5	**Practical related to Practical related to study of enzymes**			
		Subunit - b			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Textbook/s*	Sawhney S.K. and Singh R. **Introductory Practical Biochemistry.**			
	Other References	NA			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB116: Bioinstruments

L-T-P: 4-0-0 **Credit - 4**

School : SBSR		**Batch : 2020–22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	**MSB116**	
2	Course Title	**Bioinstruments**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Objective	Allow students to familiarize themselves with the specific requirements of biomedical instrumentation and biotechnology tools for enabling their intended use for research and industrial application.	
6	Course Outcomes	1. Perform experiments based on electrophoresis for separating proteins and nucleic acids. 2. Purify compounds from a mixture using column, ion-exchange, affinity chromatography, HPLC, affinity and gas chromatography. 3. Illustrate organelle and protein localization by microscopy. 4. Isolate cells by using fluorescence activated cell sorting (FACS) or magnetic activated cell sorting (MACS) and compare cell disruption techniques. 5. Conduct enzymatic and end-point assays using spectrophotometer, apply spectroscopy techniques to understand the structure of biological material. 6. Familiarize with the specific requirements of biomedical instrumentation and biotechnology tools	
7	Outline syllabus:		
7.01	**Unit 1**	**Electrophoresis**	CO1
7.02	Unit 1a	Principle of electrophoresis	
7.03	Unit 1b	Agarose gel and 2D-gel electrophoresis: Principle and applications,	
7.04	Unit 1c	Capillary and Immunoelectrophoresis: Principle and applications	
7.05	**Unit 2**	**Chromatography**	CO2
7.06	Unit 2a	Paper Chromatography, TLC	
7.07	Unit 2b	Column chromatography. Ion-exchange and Affinity chromatography	
7.08	Unit 2c	Instrumentation and applications HPLC: Instrument setup and working	
7.09	**Unit 3**	**Microscopy**	CO3
7.10	Unit 3a	Principle of microscope, Optical microscopy	

7.11	Unit 3b	AFM and Fluorescence Microscopy,	
7.12	Unit 3c	Electron Microscopy	
7.13	**Unit 4**	**Cell Separation Techniques and Centrifugation**	CO4
7.14	Unit 4a	Cell isolation and cell disruption techniques	
7.15	Unit 4b	FACS and MACS- Principle and applications; Preparative centrifugation	
7.16	Unit 4c	Differential and density gradient centrifugation, Ultracentrifugation	
7.17	**Unit 5**	**Spectrometry and Spectroscopy**	CO5
7.18	Unit 5a	Spectroscopy- Absorption and fluorescence, Atomic and Raman spectroscopy	
7.19	Unit 5b	Mass spectrometry and NMR: Instrumentation and working	
7.20	Unit 5c	X-ray crystallography: crystal preparation, working and uses.	
8	Course Evaluation		
8.1	Course work: 30 marks		
8.2	Attendance	None	
8.3	Quizzes	Three best quizzes out of Five 30-minutes quizzes in lecture hours; 10 percent	
8.4	Presentations	One: 10 percent	
8.5	Assignments	Three best out of five; 10 percent	
8.6	MST	One; 20 percent	
8.7	End-term examination: 50 percent		
9	References		
9.1	Textbook	1. Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2010.	
9.2	Other references	1. Ninfa A.J., Ballou D.P. and Benore M., "Fundamental Laboratory Approaches for Biochemistry and Biotechnology", Wiley, 2009. 2. Sheehan D., "Physical Biochemistry: Principles and Applications", Wiley, 2009	

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	1	1
CO2	2	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB118: Advances in Plant Biotechnology

L-T-P: 4-0-0 **Credit: 4**

School : SBSR		**Batch : 2020 – 22**
Program: M.Sc.		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: 02**
1	Course Code	**MSB 118**
2	Course Title	**Advances in Plant Biotechnology**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
5	Course Objective	
6	Course Outcomes	After successfully completion of this course students will be able to: 1. Will learn about tissue culture techniques applied in plant science 2. Will comprehend genetically modified plants and Transgenic plants and their economic significance 3. Will learn about the techniques for transferring gene by direct or indirect methods 4. Will be able to classify different types of molecular markers, vectors, etc 5. Will learn to apply the techniques in different field of science like ecology, environments, etc 6. Will comprehend recent advances in the field of plant biotechnology and their applications
7	Outline syllabus:	
7.01	**Unit 1**	**Techniques in Plant Tissue Culture**
7.02	Unit 1a	Concept of totipotency , Production of Secondary metabolite
7.03	Unit 1b	Haploid plant culture; Soma clonal variation, protoplast fusion and Hairy root culture
7.04	Unit 1c	Elicitors , development of High yielding varieties
7.05	**Unit 2**	**Genetic Engineering of Plants**
7.06	Unit 2a	Biotic and abiotic stress, how to develop stress resistant plant like disease resistant plants
7.07	Unit 2b	Herbicide, pesticide resistant plant production, concept of vectors
7.08	Unit 2c	Concept of vectors and their role in genetic Engineering, role of A tumefaciens
7.09	**Unit 3**	**Methods of Gene Transfer**
7.10	Unit 3a	General characteristics of gene transferring; Ti and Ri Plasmids their role.;
7.11	Unit 3b	Physical & Chemical Method of gene transfer
7.12	Unit 3c	Gene transfer technology; Advantage and disadvantage
7.13	**Unit 4**	**Molecular Markers**

7.14	Unit 4a	Concept of molecular markers, Examples of molecular markers
7.15	Unit 4b	Application of molecular markers
7.16	Unit 4c	Importance of molecular markers in crop improvements
7.17	**Unit 5**	**Application of Plant Biotechnology**
7.18	Unit 5a	Edible Vaccine; Concept of molecular and non-molecular farming
7.19	Unit 5b	Production of antibiotics
7.20	Unit 5c	Bioplastics
7.17	Course Evaluation	
8	Course work: 30 marks	
8.1	Attendance	None
8.11	Quizzes	Three best quizzes out of Five 30-minutes quizzes in lecture hours; 10 percent
8.12	Presentations	One: 10 percent
8.13	Assignments	Three best out of five; 10 percent
8.14	MST	One; 20 percent
8.15	End-term examination: 50 percent None	
9	**References**	
9.1	Textbook	1. Bhojwan S S Dantu Pk , Plant tissue culture: An Introductory Text Springer 2013
9.2	Other references	CB Nirmala G. Rajalakshmi Chandra Kartik: Plant Biotechnology. MJP publisher 2009
9.3		Stewart CN Plant Biotechnology and Genetics: Techniques and Ap[plications Wiley Interscience 2008

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB123: ADVANCED GENETIC ENGINEERING

L-T-P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-22**	
Program: M.Sc		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 2**	
1	Course Code	**MSB123**	
2	Course Title	**Advanced Genetic Engineering**	
3	Credits	4	
4	Contact H (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1.To acquire knowledge of principle and techniques involved in genetic engineering. 2.To comprehend the basic strategies of cloning and how it can be applied for human benefit. 3. To learn the use of expression vectors and their role in recombinant protein production. 4. To learn the production of transgenic plants and animals and their benefits to human beings.	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Recognize the molecular tools for genetic manipulation. CO2: Analyze different vector types and their application in construction of libraries. CO3: Describe PCR process and its applications and hybridization techniques. CO4: Explain the different types of expression vectors and their use along with methods of gene delivery. CO5: Analyze different applications of genetic engineering in various fields such as gene therapy and transgenic organisms. CO6: Describe gene transfer technologies and tools used for these methods, creation of gene libraries and various application of genetic engineering.	
7	Course Description	The 'Applied Genetic Engineering' course involves study of molecular tools in genetic engineering. It encompasses detailed procedure of genetic engineering including selection of host cells, vectors, expression vectors etc. It also involves the use of genetic engineering for mankind, creation of transgenic plants and animals.	
8	Outline syllabus		CO Mapping
	Unit 1	**Genetic engineering tools and methods**	
	A	Restriction Enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase	CO1, CO6

	B	Modifying Enzymes, Reverse transcriptase, Other important Nucleases			
	C	Cohesive and blunt end ligation; Linkers, Adaptors; Homopolymeric tailing			
	Unit 2	**Cloning**			
	A	Cloning vectors: Plasmids; PUC19 and Bluescript vectors			CO2, CO6
	B	Bacteriophages; M13 mp vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40 & retroviral vectors			
	C	Cloning methodology and selection: Insertion of foreign DNA into vectors; Transformation; Selection, Construction of libraries, cDNA and genomic libraries			
	Unit 3	***In vitro* DNA Amplification**			
	A	Nucleic acid extraction			CO3, CO6
	B	PCR,Types of PCR – multiplex, nested, reverse transcriptase, real time PCR			
	C	Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Southern and Colony hybridization			
	Unit 4	**Expression**			
	A	Expression vectors: His-tag and GST-tag based vectors			CO4, CO6
	B	Plant based vectors, Ti plasmid based Co-integrated and binary vectors; Yeast vectors, Shuttle vectors, Expression cloning			
	C	Methods gene delivery, Screening and analysis of gene expression and Diagnosis of gene expression			
	Unit 5	**Application**			
	A	Gene therapy			CO5, CO6
	B	Mutagenesis			
	C	Transgenic organisms			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Brown T.A, "Gene Cloning and DNA Analysis:An Introduction", John Wiley & Sons, 2010			
	Other References	**1. Molecular Biotechnology. Principles and Applications.** 3rd Edition. Glick BR and Pasternak JJ. ASM Press @2003. ISBN 1-55581-224-4. **2. Gene cloning and DNA Analysis- An Introduction.** 6th Edition. Wiley-Blackwell. Brown TA @2010.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	2	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	2	3
CO6	3	3	3	3	3

MSB119: Animal Cell Technology

L-T-P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2022**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 2**	
1	Course Code	**MSB 119**	
2	Course Title	**Animal Cell Technology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To acquire a fundamental knowledge of animal cell biology 2. To Study cell, tissue culture, media component 3. To Study Cell Cell Kinetics and Characteristic 4. To Study Animal cloning, cell genetics 5. To Study large scale industrial and medical applications of cell engineering.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1 Understand basics of Animal Cell and Tissue culture. Evaluate media and aseptic techniques of establishing primary and Secondary cell cultures. CO2 Establish a continuous cell line from cells of different origin and determine their nutrient and environment requirements Differentiate between adherent and non-adherent cell culture techniques, calculate growth kinetics parameters and apply cryopreservation technique for long-term storing of cells. CO3 Understanding Somatic and Germ Cell Genetics, Cell to Cell communication CO4 Scaling up of Cell cultures for industrial and medical applications. Understanding Cell cloning, Three-dimensional culture and Tissue Engineering CO5 Applications of Cell Culture, Hybridoma Technology and Antibody production, Stem cell technology CO6 Review the future perspectives, importance and ethical issues related with stem cell technology and transgenic animals.	
7	Course Description	To acquire a fundamental and advanced knowledge of Animal Cell Culture Technology by studying cell, tissue culture, media component, Animal cloning, cell genetics and large scale industrial and medical applications of cell engineering.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Cell Culture**	CO1,2,3
	A	Cell, Tissue and organ culture, Culture procedures	CO1

	B	Culture media and growth conditions, primary cultures			CO1,2
	C	Establishment and maintenance of cell lines and Risks in a tissue culture laboratory and safety.			CO2,3
	Unit 2	**Cell Kinetics and Viability**			CO3,4
	A	Cell Killing, Characterization of cultured cells-morphology of cells			CO3
	B	cell adhesion, proliferation, differentiation, Kinetics involved in growth of cultured cells,			CO4
	C	Cell viability, Methods for testing cell viability, Cytotoxicity assays			CO4
	Unit 3	**Cell Characteristics**			CO5
	A	Cell Adhesion and Signalling			CO5
	B	cell-cell communication, Cell senescence			CO5
	C	Somatic and Germ cell genetics			CO5
	Unit 4	**Scaling-up of cell cultures**			CO6,7
	A	Animal cell culture scale up, Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture			CO6
	B	Scale up in monolayer-Roller bottle culture, multisurface culture, multiarray disks, spirals and tubes monitoring of cell growth			CO 6
	C	Cell cloning and micromanipulation, Cell culture in industrial methods, Three dimensional culture and Tissue Engineering			CO7
	Unit 5	**Application of Animal Cell Culture Technology and Ethics**			CO8,9
	A	Hybridoma technology, Antibody production			CO8
	B	Transgenic animals, Applications of transgenic animals,			CO8,9
	C	Stem cells, Stem cell therapy, Ethical issues in cell culture			CO9
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Butler M., "Animal Cell Culture and Technology", Garland Science, 2008.			
	Other References	1. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006. 2. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005. 3. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB125: Bioinformatics

L T P: 4-0-0 **Credit: 4**

School: SBSR	**Batch: 2020-22**		
Program: M.Sc.	**Current Academic Year: 2020-21**		
Branch: Biotechnology	**Semester: 02**		
1	Course Code	**MSB125**	
2	Course Title	**Bioinformatics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Objective	To acquire an advanced knowledge of bioinformatics tools used for designing and analyzing *in silico* experiments and different techniques used for molecular modeling.	
6	Course Outcomes	After successfully completion of this course students will be able to: **CO1:** Understand about overview of bioinformatics scope and their disciplines. Generation of large-scale data in the field of molecular biology. **CO2:** Review of database source, database management system, Biological databases and their classification. Sequences databases and specialized databases. **CO3:** To attain knowledge about data storage model/format, retrieval of information and integration. **CO4:** Understanding about different sequence formats. Perform sequence alignment and phylogenetic prediction with different tools/software with algorithm. **CO5:** To apply different techniques for gene prediction, motif search and genome sequencing analysis. **CO6:** Basic knowledge of various bioinformatics concepts, scope, database usage, tools and software used for each application along with their algorithms.	
7	Outline syllabus:		CO Mapping
7.01	**Unit A**	**Introduction to Bioinformatics**	CO1, CO6
7.02	Unit A Topic 1	Scope and importance	
7.03	Unit A Topic 2	Large scale generation of molecular biology data	
7.04	Unit A Topic 3	Different fields in bioinformatics	
7.05	**Unit B**	**Biological Databases**	CO2, CO6

7.06	Unit B Topic 1		Introduction of Biological Databases	
7.07	Unit B Topic 2		Structural and Sequence database	
7.08	Unit B Topic 3		Specialized Genome databases and Structure databases	
7.09	**Unit C**		**Data Storage and retrieval**	CO3, CO6
7.10	Unit C Topic 1		Controlled vocabulary	
7.11	Unit C Topic 2		Introduction to Metadata; File Storage, File Format (FASTA, GenBank, Swiss-Prot, DDBJ and PDB)	
7.12	Unit C Topic 3		Boolean Search and Fuzzy Search	
7.13	**Unit D**		**Sequence-alignment Related Problems**	CO4, CO6
7.14	Unit D Topic 1		Sequence databases, Similarity matrices, pairwise alignment and BLAST	
7.15	Unit D Topic 2		Sequence assembly and multiple sequence alignment	
7.16	Unit D Topic 3		Clustal and phylogenetics, distance based approaches, parsimony	
7.17	**Unit E**		**Sequence pattern analysis & System-wide Analysis**	CO5, CO6
7.18	Unit E Topic 1		Structure of Prokaryotic and Eukaryotic gene, Basic and advanced sequencing (Maxam–Gilbert sequencing, Sanger sequencing, NGS, Pyrosequencing)	
7.19	Unit E Topic 2		Gene finding, composition-based finding, sequence motif-based finding	
7.20	Unit E Topic 3		Pattern Matching, Regular expression, Transcriptomics, Microarray technology and expression profiles	

8	Course Evaluation	
8.1	Course work: 30%marks	
8.11	Attendance	None
8.12	Homework	Three best out of 4 assignments: 20 marks
8.13	Quizzes	Two 30-minutes surprise quizzes in lecture hours: 10 marks
8.14	Projects	None
8.15	Presentations	None
8.16	Any other	None
8.2	MTE	One, 20 percent
8.3	End-term examination: 50 percent	
9	References	

9.1	Text book	Jin X., "Essential Bioinformatics", Cambridge University Press, 2006.
9.2	Other References	1. Mount D.W., "Bioinformatics: Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press, 2004. 2. Baxevanis A., Ouellette F.B.F., "Bioinformatics: A practical guide to the analysis of genes and proteins", Wiley-Interscience, 2004. 3. Bourne P.E., Gu J., "Structural Bioinformatics", Wiley-Blackwell, 2009.

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB158 Plant Biotechnology Lab

L-T-P: 0-0-3

School: SBSR		**Batch : 2020-22**	
Program: M. Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester:2**	
1	Course Code	MSB158	
2	Course Title	Plant Biotechnology Lab	
3	Credits	3	
4	Contact Hr (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To familiarize students with sterilization techniques and media preparations etc. 2. To motivate students towards plant cell and tissue culture for mass propagation. 3. To acquaint with principles, technical requirement, scientific and commercial applications in Plant Biotechnology. 4. Develop and manage plant tissue culture techniques for crop improvement.	
6	Course Outcomes	CO1: Development of ability to design and conduct experiments under controlled conditions. CO2: Development of skills for application of tissue culture techniques in plant. CO3: To Amalgamation tools for artificial germination of seeds. CO4: Perform regeneration of plant under artificial conditions. CO5: Develop transgenics and differentiate between trangenics from wild cultivars. CO6: To familiarize students with sterilization techniques and media preparations etc.	
7	Course Description	The aim of this course is to acquaint the students about the versatile tools and techniques employed in plant biotechnology. Cell and tissue culture of plants offers avenues for enhancing crop production and utilization of molecular tools in plant genome modification helps in creation of transgenic plants for combating food problems.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on introduction to plant biotechnology lab**	**CO1**
	A	Aspetic conditions maintenance in laboratory	

	B & C	Conditions optimization for growth of plant cell/tissue under conditions			
	Unit 2	**Isolation of Nucleic acids from plants and quantification**			**CO2**
	A& B	Isolation of DNA and RNA from plants			
	C	Agarose gel electrophoresis			
	Unit 3	**Seed germination on stratified media**			**CO3**
	A & B	Preparation of MS medium, Water Agar medium, Gamborg medium			
	C	Sterilization of seeds and germination on stratified medium			
	Unit 4	**Plant regeneration**			**CO4**
	A	Callus culture			
	B	Shoot regeneration			
	C	Rooting of *in vitro* raised plants			
	Unit 5	**Construct preparation and transgenics**			**CO5**
	A	Restriction of vector and gene for construct			
	B	*Agrobacterium* construct for transformation			
	C	PCR for confirmation of transgene			
	Mode of examination	Practical and/or Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s	Michael, R. G., Sambrook. J., "Molecular Cloning-A Laboratory Manual", 4th edition, Cold Spring Harbor Laboratory Press, 2012.			
	Other References	1. Giri, C. C., and Archana Giri. Plant biotechnology: Practical Manual. IK International Pvt Ltd, 2013. 2. Aneja, K. R. Experiments in microbiology, plant pathology and biotechnology. New Age International, 2007.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	2	3
CO6	3	3	3	3	3

MSB159 Genetic Engineering Lab

L-T-P: 0-0-3

School: SBSR		**Batch: 2020-22**			
Program: M.Sc.		**Current Academic Year: 2020-21**			
Branch: Biotechnology		**Semester: 02**			
1	Course Code	**MSB159**			
2	Course Title	**Genetic Engineering**			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	**Compulsory**/Elective			
5	Course Objective	To give students a introduction and hands on basic experiments of genetic engineering technique			
6	Course Outcomes	CO1: Perform experiments on DNA isolation from biological resource and understanding different methods for DNA isolation CO2: Perform experiments on RNA isolation. CO3: Validation of isolated DNA and RNA content. CO4: Amplification of particular gene of interest by PCR method. CO5: Validation of amplified gene by electrophoresis method. CO6: Performing basic experiments of Genetic engineering technique.			
7	Course Description	This course is designed to make students a thorough understanding of Database usage, tools and software for each bioinformatics applications			
8	Outline syllabus				CO Mapping
	Unit 1	**DNA isolation**			CO1
		Sub unit - a, b and c detailed in Instructional Plan			CO1
	Unit 2	**RNA isolation**			CO2
		Sub unit - a, b and c detailed in Instructional Plan			CO2
	Unit 3	**Validation of isolated DNA and RNA**			CO3
		Sub unit - a, b and c detailed in Instructional Plan			CO3
	Unit 4	**Amplification of specific gene of interest by PCR method**			CO4
		Sub unit - a, b and c detailed in Instructional Plan			CO4
	Unit 5	**Validation of amplified gene by electrophoresis method**			CO5
		Sub unit - a, b and c detailed in Instructional Plan			CO5
	Mode of exam	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	Brown T.A, "Gene Cloning and DNA Analysis:An Introduction", John Wiley & Sons, 2010.			
	Other References	1. Old R.W and Primrose S.B., "Principles of Gene Manipulation", Blackwell Scientific Publication, 2002. 2. Dale W., von Schantz M. and Plant N., "From Genes to Genomes: Concepts and Applications of DNA Technology", John Wiley, 2011.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	2	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB160: Bio-instrumentation Lab

L T P: 0-0-3 **Credits- 02**

School: SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	**MSB160**	
2	Course Title	**Bio-Instrumentation Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	**Compulsory**/Elective	
5	Course Objective	To give students a thorough understanding of tools and techniques in Biomedical and Biotechnology Laboratories. To make students learn the working and operation of various biotechnological instruments	
6	Course Outcomes	CO1: Operate autoclave, Laminar Air flow and Hot air oven and sterilize glass and plasticwares. CO2: Operate centrifuge and refrigerated centrifuge and separate cell components. CO3: Separate and visualize nucleic acids and proteins using gel electrophoresis. CO4: Operate spectrophotometer and perform absorbance assays. CO5: Separation of pigments, drugs, amino acids and hormones using chromatographic techniques. CO6: Operation and working of different instruments and bioanalytical techniques	
7	Course Description	This course is designed to make students learn about various instruments and techniques of biomedical and biotechnology laboratory and will also enable them to use and apply these techniques and equipments to solve experimental problems.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on Sterilization**	CO1
		To learn the working of an autoclave.	CO1
		To learn the working of a laminar air flow.	
		To sterilize glasswares using hot air oven.	
	Unit 2	**Practical related to centrifuge**	CO2
		Using pH meter	CO2
		Working and principle of incubator shaker	
		Working of refrigerated centrifuges	
	Unit 3	**Practical related to gel electrophoresis**	CO3
		Separation of DNA using AGE	CO3
		Separation of proteins using PAGE	

	Unit 4	**Practical related to spectrophotometer**			CO4
		Principle and working of a spectrophotometer			CO4
		Measuring concentration of protein using spectrophotometer			
	Unit 5	**Practical related to chromatography**			CO5
		Use of paper chromatography for separation of plant pigments			CO5
	Mode of exam	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Textbook/s*	Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge Press, 2010.			
	Other References	1. Cottenil R.M.S., "Biophysics: An Introduction", John Wiley and Sons, 2002. 2. Gupta A., "Instrumentation and Bioanalytical Techniques", Pragati Prakashan, 2009.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MMB201: Environmental Microbiology and Waste Management

L-T-P: 4-0-0 **Credit: 4**

School : SBSR		**Batch : 2020 – 22**
Program: M.Sc.		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: 3**
1	Course Code	MMB201
2	Course Title	Environmental Microbiology & Waste Management
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. This course provides a comprehensive introduction to microbial ecology and fundamentals of microbial diversity. 2. The course is designed to give students an up-to-date understanding of a wide array of applications of microorganisms in maintaining biogeochemical factors. 3. This course also focuses on concepts of applied environmental microbiology and how microbes can be used for various industrial/ research applications. 4. The course also highlights the modern methods of waste management and significant role of microorganisms in waste and resources management.
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Comprehend ecological interactions and role of microorganisms played in there and discuss microbial ecology concepts including methods of assessing microbial diversity and studying microbial populations. CO2: Analyze the role of microorganisms in biogeochemical cycles. CO3: Classify different methods of bioremediation and use of microorganisms and plasmids in bioremediation CO4: Explain the commercial application of microorganisms in extraction of metals, oil and in production of biogas. CO5: Identify different methods of waste management and how different microbial metabolic processes can assist in waste management. CO6: To provide a comprehensive introduction to microbial ecology and fundamentals of microbial diversity.
7	Course Description	The 'Environmental Microbiology and Waste Management' is a course designed to give students knowledge about basic concepts of environment/ ecosystem and the role microorganisms play in maintaining the ecosystem balance. This course throws light on various unconventional uses of microorganisms in various industries

		and environmental benefits of use of the microorganisms. This course also outlines various biological methods of waste management and application of microbes in bioremediation.			
8	Outline syllabus				CO Mapping
®t r	**Unit 1**	**Microbial Ecology**			
	A	Ecological Concepts: Introduction to ecosystem; types of ecosystem; food chain and food web; biological magnification and eutrophication			CO1
	B	Microbial diversity: estimates of total number of species; Shannon and Simpsons indices of microbial diversity, Unculturable bacteria			
	C	Culture independent molecular methods for understanding microbial community- Partial and whole community analysis			
	Unit 2	**Role of Microorganisms in Environment**			
	A	Role of microbes in biogeochemical cycles: nitrogen cycle: different phases of nitrogen cycle, microbes involved in different stages of nitrogen cycle			CO2
	B	Carbon, Phosphorous and Sulphur cycle			
	C	Production of microbial bio-fertilizers, bio-pesticides, soil conditioners to enhance cropyields.			
	Unit 3	**Role of Microorganisms in Remediation**			
	A	Bioremediation- *in situ* and *ex situ* techniques			CO3
	B	Biodegradation of recalcitrant compounds-lignin, pesticides; Bioaccumulation of metal and detoxification			
	C	Degradation of xenobiotics by microorganisms; Degradative plasmids			
	Unit 4	**Role of Microorganisms in Mining and Energy Production**			
	A	Microbial technology in mining: Bioleaching; Biomining; Bio-beneficiation			CO4
	B	Recovery of oil and MEOR; Bioconversions			
	C	Microbial technology for energy production- Concept of microbial fuel cell- principle; types and applications, Use of microorganisms in the production of biogas			
	Unit 5	**Role of Microorganisms in Waste Management**			
	A	Landfill- structure and types, involvement of microbes in initial adjustment phase, transition phase, acid phase			CO5
	B	Methane formation and maturation phase of a landfill operation			
	C	Compositing- types; Design and operational consideration of microbial composting			
	Mode of examination	Theory			
		CA	MTE	ETE	

	Weightage Distribution	30%	20%	50%	
	Text book/s*	**1. Environmental Science.** Ahluwalia VK, Malhotra S. Ane Books India @2006. ISBN 81-8052-023-4. **2. Environmental science.** Miller GT, SpoolMan ES. 14th Edition. Brooks/Cole @2013. ISBN 13: 978-81-315-2473-2.			
	Other References	**1. Environmental Biotechnology.** Fulekar MH. CRC Press @2014. ISBN 978-1-57808-528-8. **2. Fundamentals of Ecology.** Odum EPO and Barret W. Brooks/Cole @2005. ISBN 0534420664.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB204: Genomics

L-T-P: 4-0-0 Credit: 4

School : SBSR		**Batch : 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 3**	
1	Course Code	**MSB 204**	
2	Course Title	**Genomics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objectives	1. To comprehend the basic principles of genomics, so that may use it for understanding biological functions and apply for human benefit.. 2. To acquire knowledge of techniques and strategies involved in understanding a genome	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1. Comprehend the fundamentals of genomics and principles of DNA sequencing and analysing tools. CO2. Identify the advantages and disadvantages of various DNA sequencing methods and choose the appropriate genome analysis pipeline. CO3. Apply the concept of molecular markers and its application in genome analysis and mapping CO4. Comprehend the fundamentals of functional genomics and comparative genomics and apply it to solve problems CO5. Appreciate the power of microbial genome analysis and its application in industry, agriculture and medicine for human welfare. CO6. Be familiar with the different techniques used in genome analysis and choose rationally the appropriate methodology for solving problems.	
7	Course Description	This course provides a window to the methods and applications of genomics in the study of genomics. It gives a glimpse of the amazing world microbes that are so diverse at genome level and consequently express unique characters. It will explore how the techniques and genomic data in general have been used to understand biology. It will also indicate how this diversity can be exploited for various industries.	
8	Outline syllabus		CO Mapping
	Unit 1	**Genomic Diversity**	
	A	Concept of Genome	CO1
	B	Principles of DNA sequencing techniques, Automated DNA sequencing, Pyrosequencing, New generation Sequencing methods	CO1, CO6
	C	Primary, derivative and composite biological databases	CO1, CO6

	Unit 2	**Whole Genome Sequencing**			
	A	Whole genome sequencing methods			CO2, CO6
	B	Genome assembly and annotation			CO2, CO6
	C	Analysis of sequence data (gene prediction, conserved domain prediction, motifs), Metagenomics			CO2, CO6
	Unit 3	**Mapping techniques**			
	A	Types of genome maps,			CO3 , CO6
	B	Introduction to molecular markers (RFLP, AFLP, EST, STS, SNP)			CO3, CO6
	C	Application of markers in mapping techniques, Significance of markers in sequencing projects			CO3, CO6
	Unit 4	**Genomics**			
	A	Functional genomics, Concept of forward and reverse genomics			CO4
	B	Investigation ofgene function byreverse genomic tools, mutagenesis			CO4, CO6
	C	Comparative Genomics, application in Functional genomics			CO4, CO6
	Unit 5	**Application of Genomics**			
	A	Pharmaco-genomics and its application with special reference to SNP and SNP databases			CO5, CO6
	B	Genomics and its application in agriculture and industry			CO5, CO6
	C	Reverse vaccines, Human genome project			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1.Brown T.A., *Genomes, 3rd Edition.* Wiley-Liss (2006).			
	Other References	1. Bioinformatics and Functional genomics by Jonathan Pevsner, 2nd edition, John Wiley and Sons (2008) 2. Introduction to genomics by Arthus M. Lesk, Oxford University Press (2007)			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB207: Microbial Biotechnology

L-T-P: 4-0-0 Credit: 4

School : SBSR		**Batch : 2020-2022**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 3rd**	
1	Course Code	MSB207	
2	Course Title	**Microbial Biotechnology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Status	Compulsory	
6	Course Objective	1. Some Potential Sources of Components of Industrial Media 2. Product recovery, Solids (Insolubles) Removal 3. Industrial production of organic acids 4. Role of microorganisms in hydrocarbon degradation	
7	Course Outcomes	After studying this course, students will be able to CO1: Determine Primary and Secondary screening, Production strains, and Production media CO2: Evaluate Filtration; Centrifugation; Coagulation and flocculation CO3: Interpret the production of microbial insecticides, production of Biopolymers, Biofuels CO4: Analyze the role of microorganisms in hydrocarbon degradation CO5: Determine Role of microorganism in Bioleaching and Textile Industry. CO6: This course contains introductory part of industrial biotechnology which includes various useful microorganisms, their production, different types of fermentors, product recovery processes.	
8	Course Description	This course contains introductory part of industrial biotechnology which includes various useful microorganisms, their production, different types of fermentors, product recovery processes. After this course study student will able to learn the role of microorganisms in textile industry and marine environment.	
9	Outline syllabus		CO Mapping
	Unit 1		**CO1**
	A	Introduction and history, Isolation and screening, Primary and Secondary screening, Production strains, Production media,	
	B	Raw Materials Used in Compounding Industrial Media, Growth Factors, Water,	
	C	Some Potential Sources of Components of Industrial Media, Inoculum preparation, Introduction to Fermenter, Industrial sterilization	
	Unit 2	**Product recovery, Solids (Insolubles) Removal**	**CO2**
	A	Filtration; Centrifugation; Coagulation and flocculation;	
	B	Foam fractionation; Whole-broth treatment; Primary Product Isolation : Cell disruption;	
	C	Liquid extraction; Dissociation extraction; Ion-exchange adsorption; precipitation	

	Unit 3				**CO3**
	A	Introduction, Industrial production of penicillin, production of streptomycin			
	B	Industrial production of organic acids- production of citric acid, lactic acid, amino acids such as L- glutamic acid, production of single cell proteins, production of fermented foods,			
	C	Production of microbial insecticides, production of Biopolymers, Biofuels, Production of Alcohol Yeasts , food yeast and Baker's Yeast.			
	Unit 4	**Petroleum Microbiology**			**CO4**
	A	Types of compounds in petroleum, products of compounds in petroleum, Microorganisms in hydrocarbon system			
	B	Role of microorganisms in hydrocarbon degradation.			
	C	Marine Microbiology: Characters of marine environment, characters of marine microorganisms, role of marine microorganisms			
	Unit 5				**CO5**
	A	Production of Vaccines -Production of virus vaccines; Production of bacterial toxoids; Production of killed bacterial vaccines;			
	B	Role of microorganism in Bioleaching and Textile Industry : A. Bioleaching of elements – Microorganisms involved, chemistry of microbial leaching and beneficiation B			
	C	Textile Industry – Types of microorganisms found on textile fibres, Prevention of growth of microorganisms.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Crueger&Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition 2. Demain, A.L Biology of Industrial Microorganisms			
	Other References	1. Hobbs, B.C. and Rioberts,D 1993 Food Poisoning and Food Hygiene Edward Anold, London. 2. Hui Y H 2006 Food Biochemistry and Food Processing Blackwell 5. Joshi, V.K. Ashok Pondey 1999 Biotechnology and Food fermentation Vol. I & II. 3. Patel, A.H. Industrial microbiology			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB117 Immunology and Immunotechnology

L-T-P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: BT		**Semester: 03**	
1	Course Code	**MSB117**	
2	Course Title	**Immunology and Immunotechnology**	
3	Credits	4	
4	Contact H (L-T-P)	4-0-0	
	Course Status	**Compulsory** /Elective/Open Elective	
5	Course Objective	1. Understand immune system, immunity and various immune responses. 2. Discuss about the structure and function of antigen and antibodies; Hypersensitivity and Autoimmunity. 3. Understand the principle behind Immunization and Vaccines; Ag-Ab reactions and immune-techniques.	
6	Course Outcomes	CO1: To understand Immune system, immunity and immune responses CO2:.Discuss about the structure and function of antigen and antibodies. CO3:Discuss about Hypersensitivity and Autoimmunity. CO4: Understand the principle behind Immunization and Vaccines CO5: To understand the Antigen-antibody reactions and Immuno-techniques CO6: To acquire a fundamental working knowledge of the basic principles of immunology	
7	Course Description	The course will help students to acquire a fundamental working knowledge of the basic principles of immunology; to begin to understand how these principles apply to the process of immune function; and to develop the ability to solve problems in clinical immunology by making use of existing tools and techniques	
8	Outline syllabus		CO Mapping
	Unit 1	**Immune System and Immune responses**	
	A	Immune system: cells and organs of the immune system; Hematopoesis; Immunity and its types; Innate immunity: barriers of innate immunity; Complement system, inflammatory responses and phagocytosis	CO1
	B	Acquired immunity; Cell-mediated and humoral immunity; Activation of T-lymphocytes and B-lymphocytes	CO1
	C	Antibody-mediated and macrophage-mediated cytotoxicity; Cytokine release and their role in immune regulation;	CO1
	Unit 2	**Antigen and Antibody**	

	A	Antigen and Immunogen; Properties of an antigen; Hapten, Superantigen, Antigenicity and Immunogenicity, Adjuvants, Epitopes.			CO2
	B	Structure and function of immunoglobulin and its types			CO2
	C	Major Histocompatability Complex, BCR and TCR			CO2
	Unit 3	**Hypersensitivity and Autoimmunity**			
	A	Hypersensitivity and its types, Immunodeficiences: Severe combined immunodeficiency syndrome (SCID), Acquired immunodeficiency syndrome (AIDS)			CO3
	B	Autoimmunity; Organ-Specific Autoimmune Diseases: Hashimoto's Thyroiditis Graves' Disease, Myasthenia Gravis			CO3
	C	Systemic Autoimmune Diseases: Systemic Lupus Erythematosus, Multiple Sclerosis, Rheumatoid Arthritis			CO3
	Unit 4	**Immunization and Vaccines**			
	A	Active and passive immunization			CO4
	B	Vaccine and its properties			CO4
	C	Types of Vaccines			CO4
	Unit 5	**Antigen-antibody reactions and Immuno-techniques**			
	A	Antigen-antibody reactions: Agglutination and precipitation reactions			CO5
	B	Immunodiffusion, Immunofuorescence; RIA and types of ELISA			CO5
	C	Hybridoma technology and monoclonal antibodies; Polyclonal vs. monoclonal antibodies			CO5
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Kindt T.J., Osborne B.A. and Goldsby R.A. (2006) Kuby Immunology, W. H. Freeman			
	Other References	3. Delves P.J, Martin S.J., Burton D.R. and Roitt I.M., (2011) Roitt's Essential Immunology, Wiley			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB209: Bioprocess Technology and quality control

L-T-P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 3**	
1	Course Code	**MSB209**	
2	Course Title	**Bioprocess Technology and quality control**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Status	Compulsory	
6	Course Objective	1. Historical developments in Fermentation technology and Microbial substrates and Media formulation 2. Different mode of bioreactor operation 3. Downstream processing 4. Quality control of the fermentation Product	
7	Course Outcomes	After studying this course, students will be able to CO1: Understands basics of fermentation CO2: Describe the mode of operation of the bioreactors CO3: Understands Control in Fermentor and transport phenomena CO4: Summarize the Downstream Processing CO5: Determine the quality of the fermentation Product CO6: It includes various fermentation processes, and production of variant antibiotics.	
8	Course Description	The course comprises of general features of diverse industrial microbial organisms, their microbial substrates and media formulation. It includes various fermentation processes, and production of variant antibiotics.	
9	Outline syllabus		CO Mapping
	Unit 1	**Basics of fermentation**	
	A	Basic principle in bioprocess technology. Upstream: Media formulation, Inoculum development and aseptic transfers.	**CO1**
	B	History of fermentation, submerged and solid state fermentation, Nutrient requirements for microbial growth, Growth kinetics of microbes,	
	C	Sterilization of media and equipments for fermentation	
	Unit 2	**Different mode of bioreactor operation**	
	A	Batch, Continuous and Fed batch mode of operation,	**CO2**
	B	Operational design of Bioreactor- vessel, agitator, sparger, baffles, types of Bioreactors- STR,CSTR	
	C	CSTR, Airlift fermenter, Fluidized bed reactor, Packed bed reactor, Immobilized cells and enzymes bioreactor	
	Unit 3	**Control in Fermentor and transport phenomena**	**CO3**

	A	Measurement, monitoring and control of physical, chemical and biological parameters in a bioreactor.			
	B	Transport phenomena in bioreactor, Aeration and agitation in bioreactors.			
	C	pH and temperature control in bioreactor.			**CO4**
	Unit 4	**Downstream Processing**			
	A	Solids (Insolubles) Removal: Filtration; Centrifugation; Coagulation and flocculation; Foam fractionation; Whole-broth treatment;			
	B	Primary Product Isolation: Cell disruption; Liquid extraction; Dissociation extraction;			
	C	Ion-exchange adsorption; precipitation;			
	Unit 5	**Quality assurance (QA) of fermentation product**			**CO5**
	A	a. Detection and Quantification of the product by physicochemical, biological and enzymatic methods,			
	B	b. Sterility testing, c. Pyrogen testing – Endotoxin detection,			
	C	d. Ames test and modified Ames test, e. Toxicity testing, f. Shelf life determination			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Principles of fermentation technology, Stanbury P.F. et al, Butterworth-Heinemann Ltd, 2. Oxford Industrial Microbiology by Casida			
	Other References	1. Industrial Microbiology by Cruger 2. Food Microbiology by Frazier			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB208: CANCER BIOLOGY

L-T-P 2-0-0 Credits 2

School: SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: BT		**Semester: 03**	
1	Course Code	**MSB205**	
2	Course Title	**CANCER BIOLOGY**	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	**Elective**	
5	Course Objectives	1. Understanding about types of cancer and carcinogens 2. Acquire enough knowledge about different models and strategies of cancer research. 3. Develop the concept of various genes involved in metastasis of cancer and their signalling pathways, which in turn help in designing different therapies for it. 4. Analyse the impact of angiogenesis on cancer growth and metastasis.	
6	Course Outcomes	CO1: Identify type and stage of tumours and identify genetic/non-genetic factors involved CO2: Analyze the impact of angiogenesis and tumour microenvironment on cancer growth and metastasis CO3: Comprehend the effect of cell death in defence against cancer CO4: Assemble the several modes through which cellular environment triggers cancer and elicits immune response CO5: Evaluate the effectiveness of study models and existing screening and treatment options, identify new drug targets CO6: Understand the progression of cancer, associated risk factors, molecular mechanisms, prevention and treatment	
7	Course Description	Cancer Biology is course about the detailed introduction on types of cancer, agents causing cancer. It also helps in understanding about the molecular mechanisms of cancer establishment and its progression by the process of metastasis and angiogenesis. This course also describes about the various model system which are used to study cancer and its treatment.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Cancer Biology**	
	A	Definition and classification	CO1, CO6
	B	Cellular Oncogenes	
	C	Tumour Suppressor genes	
	Unit 2	**Characteristics of Tumour**	
	A	Invasion-metastasis-molecular mechanism	
	B	Angiogenesis-process	CO1, CO6

	C	Hypoxia and VEGF			
	Unit 3	**Autophagy and Apoptosis**			CO3, CO6
	A	Autophagy-types			
	B	Apoptosis-intrinsic and extrinsic pathways			
	C	Crosstalk between autophagy and apoptosis			
	Unit 4	**Microenvironment of tumour cells**			CO4, CO6
	A	Stroma interaction			
	B	Tumour immunology			
	C	Cancer stem cells			
	Unit 5	**Cancer prevention and treatment**			CO5, CO6
	A	Mouse models of cancers			
	B	Drug resistance and molecular diagnosis			
	C	Therapeutic approaches			
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Weinberg R.A., "The Biology of Cancer", Garland Science, 2006.			
	Other References	1. Pecorino L., "Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics", Oxford University Press, 2012. 2. Ruddon R.W., "Cancer Biology", Oxford University Press, 2007.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	2	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	2	2	2	3
CO6	3	3	3	3	3

MSB157: Immunotechnology Lab

L-T-P 0-0-3 Credit 2

School : SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 3rd**	
1	Course Code	**MSB157**	
2	Course Title	**Immunotechnology Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
5	Course Status	Compulsory	
6	Course Objective	1) This course understanding provides a strong foundation and can prompt a greater enthusiasm for and an improved understanding of the complete immune response. 2) The Work involving human samples is enticing to students with clinical interests, and further detailed protocols, and analysis guidance may be appropriate for introductory immune response.	
7	Course Outcomes	After successfully completion of this course students will be able to: CO1: understand basic laboratory techniques of blood groups CO2: estimate the haemoglobin of its own blood CO3: practical knowledge of antigen antibody interactions CO4: isolate lymphocytes for further deep analysis CO5: prepare suspension solutions of spleen and bone marrow CO6: understanding provides a strong foundation and can prompt a greater enthusiasm for and an improved understanding of the complete immune response.	
8	Course Description	The aim of this course is to acquaint the students about the versatile tools and techniques employed in immunology. The course will also provide students with a hands-on understanding of how immunology can be used to discover various processes used by animals and humans for their self defence mechanism.	
9	Outline syllabus		CO Mapping
	Unit 1		**CO1**
	A	To study permanent slides of immune tissues and organs	
	B	To find the blood group of own blood	
	C	To find the Rh factor of own blood group	
	Unit 2		**CO2**
	A	To estimate the amount of Hb present in human blood	
	B	To perform Rocket immunoelectrophoresis	
	C	To perform Separation of lymphocytes	
	Unit 3		**CO3**
	A	To perform Sandwich enzyme linked immunosorbant assay	
	B	To perform DoT ELISA	
	C	To perform Haemagglutination test	
	Unit 4		**CO4**
	A	To perform Ouchlerlony's double immunodiffusion method.	

	B	To perform Radial Immunodiffusion			
	C	To perform RIA			
	Unit 5				**CO5**
	A	Preparation of single cell suspension of spleen.			
	B	Preparation of single cell suspension of bone marrow.			
	C				
	Mode of examination	Practical/or Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.			
	Other References	Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	2
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB259: Microbial Biotechnology Lab

L-T-P 0-0-3 Credit 2

School: SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: BT		**Semester: 3rd**	
1	Course Code	**MSB259**	
2	Course Title	**Microbial Biotechnology Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Compulsory/Elective	
5	Course Objective	• To develop practical knowledge of microorganism • To teach students about fermentor; other instruments and their components • To teach about microbial production of various biomolecules	
6	Course Outcomes	CO1:Practical knowledge of fermentor other instruments and their components CO2: Isolation and screening of microorganisms CO3: Practical knowledge of solid state fermentation. CO4: Able to produce different biomolecules CO5: Cradle to grave knowledge of microbial process engineering. CO6: Understanding of basic experimental set up, scale up process, and practices of various microbial cultures in biomolecules production	
7	Course Description	**Microbial Biotechnology**, is a specialization of biotechnology, It deals with the design and development of reactor and processes for the manufacturing of products such as like enzymes, acids, biopolymers etc. This lab covers the design of bioreactor and its operations.	
8	Outline syllabus		CO Mapping
	Unit 1	**Isolation and screening of microorganism**	**CO1, CO5**
		Isolation and screening of microorganism producing proteases	
		Isolation and screening of microorganism producing amylases	
	Unit 2	**Isolation and screening of microorganism**	**CO2, CO5**
		Isolation of Nitrogen fixers from soil	
		Isolation of phosphate solubilizers from soil	
	Unit 3	**Microbial Growth Kinetics**	**CO2, CO5**
		Estimation of effect of temperature on microbial growth	
		Estimation of effect of pH on microbial growth	
	Unit 4	**Microbial fermentation**	**CO4, CO5**
		Fermentative production of Wine	
		Fermentative production of Beer	

	Unit 5	**Microbial fermentation**			**CO4, CO5**
		Fermentative production of Amylase			
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References				

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB256: Genomics and Bacterial Genetics Lab
L-T-P 0-0-3 Credits 2

School: SBSR		**Batch: 2020-22**			
Program: M.Sc.		**Current Academic Year: 2020-21**			
Branch: Biotechnology		**Semester: 3**			
1	Course Code	MSB256			
2	Course Title	Genomics and Bacterial Genetics Lab			
3	Credits	2			
4	Contact Hours (L-T-P)	0-0-3			
	Course Status	Compulsory			
5	Course Objective	To learn methods of gene prediction, annotation and sequence analysis and Microbial genetics. Understand how gene expression is controlled.			
6	Course Outcomes	After finishing the course the students will be able to CO1: Learn about various biological databases and their operations. CO2: Sequence retrieval and sequence alignment using various softwares. CO3: Identify the various ORFs in an unknown sequence. CO4: Find out if any protein is being encoded by the sequence and its characteristics. CO5: Will be able to isolate plasmid from the bacterial cells and perform restriction digression studies on it. CO6: Design experiments, analyse experimental results and communicate data through writing			
7	Course Description	The course aims to appraise the students to basic and high throughput techniques in Genomics and Bacterial genetics and their applications.			
8	Outline syllabus				CO Mapping
	Unit 1	**Practical related to Biological Databases**			
		Sub unit – a ,b, c			CO1, CO6
	Unit 2	**Practical related to alignment**			
		Sub unit –c			CO2, CO6
	Unit 3	**Practical based to Microbial strain**			
		Sub unit- a			CO3, CO6
	Unit 4	**Practical related to Microbial genetics**			
		Sub unit – c			CO4, CO6
	Unit 5	**Practical based upon Microbial Genome Analysis**			
		Sub unit - a			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	

List of Practical's:

Week 1	**Unit 1**	**Practical based on**	
Week 1-2	a	Lab expt.1	Find out the major data bases dealing with primary data along with their home server address.
Week 3		Lab expt.2	Align all the nucleotide sequences provided using bioedit . Translate one of them into amino acid in all six frames. Give the graphic view and mark the conserved regions.
	Unit 2	**Practical related to study**	
Week 4	b	Lab expt.3	Perform BLAST nucleotide for the nucleotide sequence provided and predict the gene. Report the most similar accession number and give its detail.
		Lab expt.4	To perform ORF scan on the given sequence and find out the viable ORFs.
	Unit 3	**Practical based upon**	
Week 5	a	Lab expt.5	Perform BLAST and find out the conserved domain number and protein family number for it.
Week 6	b	Lab expt.6	Prepare a pure culture of a bacterial strain.
Week 7	Mid term		
	Unit 4	**Practical based upon study**	
Week 8	a	Lab expt.7	Isolate plasmid from bacterial cells.
Week 9-10	b	Lab expt.8	Perform Restriction digestion of isolated plasmids
	Unit 5	**Practical related**	
Week 11-14	a, b and c	Lab expt.9	Conduct PCR for specific Genes in Bacteria
		Lab expt.10	Quantify and Analysis Bacterial Genome

	Text book/s*	Genomics And Proteomics Principles Technologies And Applications byTaylor & Francis June 2017 ISBN 9781771881142	
	Other References	Practical Microbiology by CKJ Panker, Orient Longman. 2017	

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	2	3	2
CO5	1	1	1	1	3
CO6	3	3	3	3	3

MSB260: Bioprocess Technology Lab

L-T-P 0-0-3 Credit 2

School: SBSR		**Batch: 2020-22**	
Program: M.Sc.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 3rd**	
1	Course Code	**MSB260**	
2	Course Title	**Bioprocess Technology Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory/Elective	
5	Course Objective	• To develop practical knowledge of microorganism • To teach students about fermentor; other instruments and their components • To teach about microbial production of various biomolecules	
6	Course Outcomes	CO1:Practical knowledge of fermentor other instruments and their components CO2: Isolation and screening of microorganisms CO3: Practical knowledge of solid state fermentation. CO4: Able to produce different biomolecules CO5: Cradle to grave knowledge of microbial process engineering. CO6: Understanding of basic experimental set up, scale up process, and practices of various microbial cultures in biomolecules production	
7	Course Description	**Microbial Biotechnology**, is a specialization of biotechnology, It deals with the design and development of reactor and processes for the manufacturing of products such as like enzymes, acids, biopolymers etc. This lab covers the design of bioreactor and its operations.	
8	Outline syllabus		CO Mapping
	Unit 1	**Isolation and screening of microorganism**	**CO1, CO5**
		Isolation and screening of microorganism producing proteases	
		Isolation and screening of microorganism producing amylases	
	Unit 2	**Isolation and screening of microorganism**	**CO2, CO5**
		Isolation of Nitrogen fixers from soil	
		Isolation of phosphate solubilizers from soil	
	Unit 3	**Microbial Growth Kinetics**	**CO2, CO5**
		Estimation of effect of temperature on microbial growth	
		Estimation of effect of pH on microbial growth	
	Unit 4	**Microbial fermentation**	**CO4, CO5**
		Fermentative production of Wine	

		Fermentative production of Beer			
	Unit 5	**Microbial fermentation**			**CO4, CO5**
		Fermentative production of Amylase			
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References				

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	2	1
CO2	2	3	1	1	1
CO3	1	1	3	2	2
CO4	1	1	1	3	1
CO5	1	2	2	2	3
CO6	3	3	3	3	3