Programme Structure

Sharda School of Engineering & Technology

Department of Biotechnology

M.Sc Genetic Engineering
Programme code: SET0206
(Batch: 2023-2025)

The components of the curriculum

Course Component	Curriculum Content (% of total number of credits of the programme)	Total number of contact hours	Total number of credits
Basic Sciences	2.38%	2	2
Engineering Sciences	26.19%	25	22
Humanities and Social sciences	2.38%	4	2
Programme Core	47.61%	51	40
Programme Electives	9.54%	8	8
RBL and Dissertation	11.9%	24	10

Department of Biotechnology
Sharda School of Engineering & Technology
Sharda University, Greater Noida
M.Sc Genetic Engineering
Programme Structure
Academic Year: 2023-2024

TERM: I

S. No.	Paper ID	Course Code	Course	Teaching Load			Credits	Type of course 1. CC 2. AECC 3. SEC 4. DSE
				L	T	P		
THEORY SUBJECTS								
1.	16638	MGE101	Advanced Cell Biology	4	0	0	4	CC
2.	16639	MGE102	Structure and Function of Biomolecules	4	0	0	4	AECC
3.	16640	MGE103	Molecular Biology	4	0	0	4	AECC
4.	16641	MGE104	Molecular cloning	4	0	0	4	AECC
5.	30055	MST111	Biostatistics	2	0	0	2	SEC
PRACTICAL								
6	16642	MGP101	Advanced Cell Biology lab	0	0	4	2	SEC
7	16643	MGP102	Macromolecules lab	0	0	4	2	SEC
8	16644	MGP103	Molecular Biology Lab	0	0	4	2	SEC
9		MGP106	Research Based Learning - I	0	0	2	0	CC (Qualifying)
TOTAL CREDITS							**24**	

TERM: II

S. No.	Paper ID	Course Code	Course	Teaching Load			Credits	Type of Course
				L	T	P		
THEORY SUBJECTS								
1.	16834	MGE105	Advances in Immunology	4	0	0	4	AECC
2.	16835	MGE106	Metabolic Pathways	4	0	0	4	AECC
3.	16836	MGE107	Techniques in Biology	4	0	0		DSE
		MGE110	Animal Biotechnology	4	0	0	4	DSE
4.	16837	MGE108	Bioinformatics	4	0	0	4	SEC
5.	16838	MGE109	Transgenic Organisms	4	0	0	4	AECC
PRACTICAL								
6.	16839	MGP104	Techniques in Biology Lab	0	0	4	2	CC
7.	16840	MGP105	Bioinformatics lab	0	0	4	2	SEC
8	16119	CCU101	Community connect	0	0	4	2	SEC
9.		MGP107	Research Based Learning - II	0	0	2	0	CC (Qualifying)
TOTAL CREDITS							**26**	

TERM: III

S. No.	Paper ID	Course Code	Course	Teaching Load			Credits	Type of Course
				L	T	P		
THEORY SUBJECTS								
1.	16846	MGE201	Industrial Microbiology	4	0	0	4	AECC
2.	16847	MGE202	Genomics and Proteomics	4	0	0	4	AECC
3.	16848	MGE203	Cancer and Stem Cell Biology	4	0	0	4	CC
4.	16849	MGE204	Clinical Biotechnology	4	0	0		DSE
		MGE206	Plant Biotechnology	4	0	0	4	DSE
5.	16850	MGE205	Enzyme Technology	4	0	0	4	CC
PRACTICAL								
6.	16851	MGP201	Industrial Microbiology lab	0	0	4	2	SEC
7.	16852	MGP202	Genomics and Proteomics lab	0	0	4	2	SEC
8.		MGP203	Dissertation-Part I/Research Based Learning - III	0	0	4	2	CC
TOTAL CREDITS							**26**	

TERM: IV

S. No.	Paper ID	Course Code	Course	Teaching Load			Credits	Type of Course
				L	T	P		
PRACTICAL								
1.		MGP205	Dissertation-Part II/Research Based Learning - IV	0	0	16	08	CC
TOTAL CREDITS							**08**	

Course Modules

(M.Sc Genetic Engineering)

MGE101 Advanced Cell Biology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester:1	
1	Course Code	MGE101	
2	Course Title	Advance Cell Biology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) Many of the advancements in modern science are the result of a better understanding of cellular components and their functions. (2) At the end of the course, the students can gain in-depth knowledge of cell biology, which provides information about the composition, structure and function of organelles and other cellular components and their biological activities.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Analyze the structure, function of plasma membrane, cytoplasm and its composition. CO2:Inspect the structure and function of various intracellular organelles CO3:Examine the concept of cytoskeleton and its regulatory function. CO4:Discuss the structure of chromatin and chromosomes CO5:Discuss the general principles of cell communication, cell adhesion and roles of different adhesion molecules CO6:Develop the in-depth knowledge of cell biology, various cellular organelles, their structure and function	
7	Course Description	The focus of cell biology is the study of the structure and function of the cell. In this course, we will cover topics such as plasma membrane structure and composition, transport, cell organelles, cytoskeleton and cell movement, structure of chromatin, chromosome, and general principle of cell communication, cell adhesion and roles of different adhesion molecules.	
8	Outline syllabus		CO Mapping
	Unit 1	**Cellular organization**	CO1, CO6
	A	Plasma Membrane and its Functions in Transport	CO1, CO6
	B	Exocytosis and Endocytosis	CO1, CO6
	C	Cytoplasm and its Composition, electrical properties of membranes	CO1, CO6
	Unit 2	**Intracellular organelles**	CO2, CO6
	A	Structure and function of Cell wall, nucleus,	CO2, CO6

		mitochondria			
	B	Structure and function of Golgi bodies, lysosomes, endoplasmic reticulum,			CO2, CO6
	C	Structure and function of peroxisomes, plastids, vacuoles, chloroplast			CO2, CO6
	Unit 3	**Cytoskeleton and Cell Dynamics**			CO3, CO6
	A	Structures and assembly of Cytoskeleton and its Regulation			CO3, CO6
	B	Molecular Motors, microfilaments and microtubules			CO3, CO6
	C	Role of cytoskeleton in motility			CO3, CO6
	Unit 4	**Organization of Gene and chromosome**			CO4, CO6
	A	Structure of chromatin and chromosomes, Heterochromatin, Euchromatin, transposons			CO4, CO6
	B	Gene concept, Structural and numerical alterations of chromosomes.			CO4, CO6
	C	Cell cycle; mitosis and meiosis and their regulation			CO4, CO6
	Unit 5	**Cellular communication**			CO5, CO6
	A	General principles of cell communication, cell adhesion and roles of different adhesion molecules			CO5, CO6
	B	Gap junctions, extracellular matrix, integrins			CO5, CO6
	C	Neurotransmission and its regulation			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Devasena.T (Ed.) (2012), *Cell Biology*. Oxford University Press India; First edition, ISBN: 978-0198075516 2.Rastogi S.C (Ed.) (2008), *Cell Biology*. Newagepublishers , ISBN: 978-8122416886			
	Other References	1. Cox, Michael & Nelson, David (Eds) (2000), *Lehninger Principles of Biochemistry*. W.H. Freeman company New York 4th edition. ISBN: 978-1429234146 2.Garrett Grisham (Ed) (1999), *Biochemistry*. International student's edition. Cengage Learning, 3'rd edition, ISBN: 978-1133108795 5.Karp G (Ed.) (2016), *Cell and Molecular Biology: Concepts and Experiments*. John Wiley & Sons. ISBN:			

		978-0470042144 6.De Robertis E.D.P & De Robertis E.M.F (Eds.) (2006), *Cell and Molecular Biology*. ISBN: 978-8184734508 7.Cooper, G.M. and Hausman, R.E (Eds) (2013), *The Cell: A Molecular Approach*. Sinauer Associates, Inc.; 6 edition, ISBN: 978-1605351551	

MGE203 Cancer and Stem Cell Biology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGE203	
2	Course Title	Cancer and Stem Cell Biology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) To learn the biology and genetics of cancer and the genetic basis of cancer therapy. (2) To learn the basics of stem cell biology and its application in healthcare	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Discuss on biology and genetics of cancer CO2:Examine the signaling pathways and therapeutic resistance involved in cancer CO3:Categorize the various mechanism of angiogenesis and metastasis CO4:Examine knowledge about stem cells and their characteristics, embryonic stem cells and stem cell niche. CO5:Discuss about the applications of stem cells in tissue engineering and treatment of human diseases CO6:Discuss Cancer biology and Stem cell applications.	
7	Course Description	This course provides understanding about the causes and mechanism of cancer and its spread and therapeutics. It also elaborates about the stem cells, their types and application in tissue engineering and diseases treatment.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Cancer**	CO1, CO6
	A	Definition of cancer, history of cancer research, DNA stability and its role in cancer development	CO1, CO6
	B	Growth factors and their role in cancer, Overview of the hallmarks of cancer.	CO1, CO6
	C	Physical and chemical carcinogens.	CO1, CO6
	Unit 2	**Gene Expression and Cancer**	CO2, CO6
	A	Proto-oncogenes, oncogenes and tumor suppressor genes, Mechanisms of oncogene activation, Role of growth	CO2, CO6

		factors and receptors in carcinogenesis,			
	B	Signaling in cancer, role of Ras, p53, myc, Rb, mTor pathways,			CO2, CO6
	C	Telomeres, cellular immortalization, and Apoptosis			CO2, CO6
	Unit 3	**Metastasis and Angiogenesis**			CO3, CO6
	A	Metastasis; Migration & Invasion, Metastasis steps, Epithelial to Mesenchymal Transition			CO3, CO6
	B	Angiogenesis; Hypoxia and VEGF, Stroma interaction; Impact of Tumor-Stroma Interaction on Tumor Development,			CO3, CO6
	C	Angiogenesis- factors and process, Prevention and treatments for cancer			CO3, CO6
	Unit 4	**Stem Cells and Their Types**			CO4, CO6
	A	Properties of Stem cells, proliferation, medical applications of stem cells			CO4, CO6
	B	Types of stem cells- embryonic stem cell, Adult stem cell,			CO4, CO6
	C	Cancer Stem cells			CO4, CO6
	Unit 5	**Therapeutic Applications of Stem Cells**			CO5, CO6
	A	Cell replacement therapy, application of stem cells in Neurological diseases, Immunotherapy			CO5, CO6
	B	drug screening and toxicology, tissue remodelling, cancer treatment and development of scaffolds.			CO5, CO6
	C	Ethical and legal issues in use of stem cells.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Bunz F (Ed.) (2016), *Principles of Cancer Genetics*, (2016) Springer Science, Second Edition, ISBN: 978-94-024-1357-1			
	Other References	1. Sell S (Ed.) (2004), *Stem Cells Handbook*, Humana Press, Second Edition, ISBN: 1588291138			

MGE205 Enzyme Technology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGE205	
2	Course Title	Enzyme Technology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	This course will result in understanding of (1) The importance and role of Enzymes in biological processes (2) Kinetics, Mechanism & Regulation of enzymes (3) Applications of enzymes in Medical, Biotechnological, industrial and Agricultural fields.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Discuss the nature, power and purification of enzymes. CO2:Inspect the steady state and pre-steady state kinetics and mechanism of enzyme action. CO3:Examine and appreciate the intricate mechanism of enzyme regulation and inhibition. CO4:Analyze and appreciate the application of enzymes and immobilized enzymes CO5:Discuss the different applications of enzymes in different areas of health, industry and in food industry. CO6:Discuss all the basic information necessary to understand, appreciate and utilize enzymes in their higher studies and research in biotechnology.	
7	Course Description	This course will provide the basic understanding of the nature and properties of Enzymes. The students will learn, isolation, purification of enzymes and would also learn about the mechanism and kinetics. The students will be able to appreciate the application of enzymes in various sectors including Biotechnology.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Enzymes**	CO1, CO6
	A	Enzyme as biocatalysts, classification, nomenclature of enzymes	CO1, CO6
	B	extraction, isolation and large scale production and purification of enzymes.	CO1, CO6

	C	Cofactors and their role in enzyme activity			CO1, CO6
	Unit 2	**Mechanism of Enzyme Action**			CO2, CO6
	A	Concept of active site and energetics of enzyme-substrate complex formation, specificity of enzyme action; kinetics of enzyme action			CO2, CO6
	B	estimation of Michaelis-Menten's parameters;			CO2, CO6
	C	multi-substrate reactions-mechanisms & Kinetics, Hill's Plot, Scatchard Plot			CO2, CO6
	Unit 3	**Regulation of Enzymes and their inhibition**			CO3, CO6
	A	Enzyme inhibition, Enzyme Inhibitors, Competitive, uncompetitive and non-competitive inhibition.			CO3, CO6
	B	Mechanism, general principles, theories with examples of Chymotrypsin and Lysozyme, Feedback inhibition, allosteric and cooperativity, Isoenzymes, Covalent and non-covalent modification:			CO3, CO6
	C	examples of Glycogen phosphorylase, Aspartate transcarbamoylase.			CO3, CO6
	Unit 4	**Immobilized Enzymes**			CO4, CO6
	A	Immobilization of enzyme and whole cells; Methods of immobilization –ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment.			CO4, CO6
	B	Process design and operation strategies for immobilized enzyme reactors, Immobilization of multiple enzyme system and immobilized enzymes in industrial processes.			CO4, CO6
	C	Enzymes modification and site directed mutagenesis.			CO4, CO6
	Unit 5	**Applications of Enzymes**			CO5, CO6
	A	Importance of enzymes in diagnostics, Enzyme pattern in diseases like Myocardial infarctions (SGOT, SGPT & LDH).			CO5, CO6
	B	Use of isozymes as markers in cancer and other diseases. Enzymes in immunoassay techniques.			CO5, CO6
	C	Enzymes used in detergents, use of proteases in food, leather and wool industries, starch hydrolyzing enzymes, uses of lactase in dairy industry, glucose oxidase and catalase in food industry.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Price and Stevenson (Eds) (2009), *Fundamentals Of Enzymology*, 3rd Edition, Oxford University Press.			

		ISBN: 978-0198064398	
	Other References	1.Cox, Michael & Nelson, David (Eds) (2000), *Lehninger Principles of Biochemistry*. W.H. Freeman company New York 4th edition. ISBN: 978-1429234146	

MGP106 Research Based Learning I

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester I	
1	Course Code	MGP106	
2	Course Title	Research Based Learning 1	
3	Credits	Audit Based	
4	Contact Hours (L-T-P)	(0-0-2)	
	Course Status	Compulsory	
5	Course Objective	(1) Develop an interest towards research	
6	Course Outcomes	**CO1:** Design and develop the research-based investigation carried out onproblems in molecular biology and interdisciplinary science **CO2:** Examine and compare a research article with a review article or a survey-based article **CO3:** Develop the capacity to follow research articles **CO4:** Discuss the various components of Genetic Engineering referred in research articles **CO5:** Explain the important results of research findings **CO6:** Elaborate the research findings in written and verbal forms	
7	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
8	Outline		CO Mapping
	Part 1	Introduction to various research problems	CO1, CO6
	Part 2	Identify a research question	CO2, CO6
	Part 3	Literature survey	CO3, CO6
	Part 4	Report writing	CO4, CO6
	Part 5	Presentation	CO5, CO6
	Mode of Examination	1. Rubric assessment 2. Monthly Presentation to be audited by supervisor	

		3. Mid Term Presentation and End Term Presentation	
	Text book/s*	10 Recent International Journal Articles of repute.	
	Other References	-	

MGP107 Research Based Learning II

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: II	
1	Course Code	MGP107	
2	Course Title	Research Based Learning 2	
3	Credits	Audit Based	
4	Contact Hours (L-T-P)	(0-0-2)	
	Course Status	Compulsory	
5	Course Objective	(1) Develop an interest towards research	
6	Course Outcomes	**CO1:** Design and develop the research-based investigation carried out onproblems in molecular biology and interdisciplinary science **CO2:** Examine and compare a research article with a review article or a survey-based article **CO3:** Develop the capacity to follow research articles **CO4:** Discuss the various components of Genetic Engineering referred in research articles **CO5:** Explain the important results of research findings **CO6:** Elaborate the research findings in written and verbal forms	
7	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
8	Outline		CO Mapping
	Part 1	Introduction to various research problems	CO1, CO6
	Part 2	Identify a research question	CO2, CO6
	Part 3	Literature survey	CO3, CO6
	Part 4	Report writing	CO4, CO6
	Part 5	Presentation	CO5, CO6
	Mode of examination	1. Rubric assessment 2. Monthly Presentation to be audited by supervisor 3. Mid Term Presentation and End Term Presentation	

	Text book/s*	10 Recent International Journal Articles of repute.	
	Other References	-	

MGP203 Research Based Learning III/Dissertation Part I

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGP203	
2	Course Title	Research Based Learning III/Dissertation Part I	
3	Credits	1	
4	Contact Hours (L-T-P)	(0-0-2)	
	Course Status	Compulsory	
5	Course Objective	(1) Develop knowledge of a specific area of specialization. (2) Develop research skills especially in project writingand oral presentation.	
6	Course Outcomes	**CO1:** Design and develop the research-based investigation carried out onproblems in molecular biology and interdisciplinary science **CO2:** Examine and compare a research article with a review article or a survey-based article **CO3:** Develop the capacity to follow research articles **CO4:** Discuss the various components of Genetic Engineering referred in research articles **CO5:** Explain the important results of research findings **CO6:** Elaborate the research findings in written and verbal forms	
7	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
8	Outline		CO Mapping
	Part 1	Introduction to various research problems	CO1, CO6
	Part 2	Identify a research question	CO2, CO6
	Part 3	Literature survey	CO3, CO6
	Part 4	Report writing	CO4, CO6
	Part 5	Presentation	CO5, CO6

	Mode of examination	1. Rubric assessment 2. Monthly Presentation to be audited by supervisor 3. Mid Term Presentation and End Term Presentation			
	Weightage	CA	CE (Viva)	ETE	
		25%	25%	50%	
	Text book/s*	10 Recent International Journal Articles of repute.			

MGP205 Research Based Learning IV/Dissertation Part II

School: SSET		Batch: 2023-25	
Programme: M. Sc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		**Semester III**	
1	Course Code	MGP205	
2	Course Title	Research Based Learning IV/Dissertation Part II	
3	Credits	16	
4	Contact Hours (L-T-P)	(0-0-8)	
	Course Status	Compulsory	
5	Course Objective	(1) Develop knowledge of a specific area of specialization. (2) Develop research skills especially in project writingand oral presentation.	
6	Course Outcomes	**CO1:** Recognize research-based investigation carried out on problems in molecular biology and interdisciplinary science **CO2:** Understand and compare a research article with a review article or a survey-based article **CO3:** Demonstrate capacity to follow research articles **CO4:** Identify concepts of molecular biology referred in research articles **CO5:** Explain the important results of research findings **CO6:** Discuss the research findings in written and verbal forms	
7	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
8	Outline		CO Mapping
	Part 1	Introduction to various research problems	CO1, CO6
	Part 2	Identify a research question	CO2, CO6
	Part 3	Literature survey	CO3, CO6
	Part 4	Report writing	CO4, CO6
	Part 5	Presentation	CO5, CO6

	Mode of examination	4. Rubric assessment 5. Monthly Presentation to be audited by supervisor 6. Mid Term Presentation and End Term Presentation			
	Weightage	CA	CE (Viva)	ETE	
		25%	25%	50%	
	Text book/s*	10 Recent International Journal Articles of repute.			

Syllabus of Ability Enhancement Compulsory Courses

MGE102: Structure and Function of Biomolecules

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester:1	
1	Course Code	MGE102	
2	Course Title	Structure and Function of Biomolecules	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1)This paper trains students to appreciate the salient features of biomolecules in the organization of life. (2)It helps the students in understanding the classification, functions and application aspects of biomolecules.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Analyze the principles of biochemistry CO2:Examine the structure, classifications and function of carbohydrates. CO3:Discuss the structure, types and functions of lipids. CO4:Explain the structure, classifications and function of proteins. CO5:Discuss structure, classifications and function of nucleotides and nucleic acids CO6:Develop the in-depth knowledge about structure and function of various biomolecules	
7	Course Description	The focus of this subject is to understand the structure and function of various biomolecules namely carbohydrates, lipids, proteins and nucleic acids.	
8	Outline syllabus		CO Mapping
	Unit 1	**Principles of biochemistry**	CO1, CO6
	A	Structure of atoms, molecules and chemical bonds, Van der Waals, electrostatic interaction	CO1, CO6
	B	Hydrogen bonding, Hydrophobic interaction, pH, buffer	CO1, CO6
	C	Reaction kinetics, thermodynamics, colligative properties	CO1, CO6
	Unit 2	**Carbohydrates**	CO2, CO6
	A	Classification of carbohydrates, Composition, structure and function of Monosaccharides, oligosaccharides and	CO2, CO6

		polysaccharides			
	B	Structure and functions of polysaccharides such as starch, cellulose, glycogen and chitin, Glycation and glycosylation of proteins,			CO2, CO6
	C	Physical and chemical properties of carbohydrates, Gycosoaminoglycans and proteoglycans.			CO2, CO6
	Unit 3	**Lipids**			CO3, CO6
	A	Classification, structure and function of lipids, fatty acids and triglycerides, phospholipids and their types, Sterols and steroid hormones			CO3, CO6
	B	Sphingolipids, eicosanoids, vitamins. Action of pain killers, Chemical nature of blood groups			CO3, CO6
	C	Disease related to lipid metabolism. Purification and characterization of lipids.			CO3, CO6
	Unit 4	**Amino acids and proteins**			CO4, CO6
	A	Structure and classification of amino acids, chemical and physical properties of amino acids			CO4, CO6
	B	Levels of protein structure-primary, secondary (Ramachandran plot, secondary structure, domains, motif and folds), tertiary and quaternary			CO4, CO6
	C	Chemical synthesis of peptides. Methods of sequencing of peptide and proteins. Structure of hemoglobin, myoglobin, collagen and keratin.			CO4, CO6
	Unit 5	**Nucleotides and Nucleic acids**			CO5, CO6
	A	Structure of Purines and Pyrimidines, nucleosides and nucleotides. Structure and function of DNA and its different forms, RNA and their types			CO4, CO6
	B	Denaturation and renaturation of DNA, DNA methylation and its role.			CO4, CO6
	C	Nucleotides as energy molecules, enzyme cofactors and regulatory molecules.			CO5, CO6
	Mode of examination				
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Cox MM and Nelson DL (Eds) (2000), Lehninger Principles of Biochemistry. W.H. Freeman company New York 4th edition. ISBN: 978-1429234146			
	Other References	2. Jain JL (Ed.) (1994), Fundamentals of Biochemistry, S.Chand and Company 4th edition,, ISBN: 978-8121924535			

		3. Chatterjea MN and Ranashinde (Eds.) (2005), *Textbook of Medical biochemistry*, Jaypee Brothers Medical Publisher (P) Ltd, 6th edition, ISBN: 978-93-5025-484-4 4. Pamela C. Champe, Richard A. Harvey (Eds.) (2007). *Lippincott's illustrated biochemistry*, Lippencott - Raven Publishers, 6th edition 2007., ISBN: 0397510918 5. Voet D and Voet, JG (Eds.) (2004), *Biochemistry*, John Wiley & Sons, ISBN: 978-0471193500	

MGE103 Molecular Biology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		**Semester: 1**	
1	Course Code	MGE103	
2	Course Title	Molecular Biology	
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 central dogma of life relating processes of replication, transcription and translation. (2) To understand the different theories of recombination. (3) To learn about the fundamental concept of regulatory RNA.	
6	Course Outcomes	CO1:Analyze the difference between prokaryotic and eukaryotic replication, compare prokaryotic and eukaryotic transcription and examine the functions of different types of RNA polymerases. CO2:Elaborate the regulation of transcription and identify post-transcriptional modifications. CO3: Explain the process of translation in prokaryotes and eukaryotes and presence of post translational modification CO4:Examine the process of recombination and formation of Holliday junction. CO5:Inspect the role of viral oncogenes, cellular oncogenes and tumour suppressor genes and proteins in cancer. CO6:Discuss the various aspects of central dogma and DNA repair mechanisms.	
7	Course Description	Molecular biology is a course to acquire a fundamental knowledge of central dogma of life relating processes of replication, transcription and translation. To understand the different theories of recombination. To learn about the fundamental concept of regulatory RNA.	
8	Outline syllabus		CO Mapping
	Unit 1	**DNA replication, repair and recombination**	CO1, CO6
	A	Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication	CO1, CO6
	B	Extrachromosomal replicons, DNA damage and repair mechanism	CO1, CO6
	C	homologous and site-specific recombination	CO1, CO6

	Unit 2	**RNA synthesis and processing**	
	A	Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination	CO2, CO6
	B	RNA processing, RNA editing, splicing, and polyadenylation.	CO2, CO6
	C	Structure and function of different types of RNA, RNA transport	CO2, CO6
	Unit 3	**Protein synthesis and processing**	CO3, CO6
	A	Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA	CO3, CO6
	B	tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading	CO3, CO6
	C	translational inhibitors, Post-translational modification of proteins	CO3, CO6
	Unit 4	**Control of gene expression**	CO4, CO6
	A	Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.	CO4, CO6
	B	Operons and their regulation	CO4, CO6
	C	Histone modifications and their effects on gene expression, acetylation and methylation.	CO4, CO6
	Unit 5	**Regulatory RNAs**	CO5, CO6
	A	Riboswitches, RNAs as defense agents	CO5, CO6
	B	CRISPR system in bacteria, CRISPR-Cas9 for genome editing, CRISPRi and CRISPRa for gene regulation.	CO5, CO6
	C	Synthesis and function of miRNA molecules, silencing of gene expression by small RNAs, RNAi, long noncoding RNAs and X-inactivation	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
	Text book/s*	1. Brown TA (Ed.) (1991), *Molecular Biology Lab Fax. B*ios Scientific Publishers Ltds., Oxford, 1991, ISBN: 9780121360559	
	Other References	1. James D. Watson et al., (Eds.). (1987), *Molecular Biology of the Gene*, Volume II (4th Edition) 4th Edition, Benjamin Cummings, ISBN: 978-0805396133	

		2. Darnell J, Lodish H and Baltimore D (Eds.) (1994), *Molecular Cell biology*, 2nd Edition, Scientific American Books, USA, 1994, ISBN: 978-0805396133 3. Alberts B, et al., (Eds.) (1994), *Molecular Biology of the Cell*, Garland publishing. Inc., New York, 2nd Edition, ISBN: 0-8153-4072-9	

MGE 104 Molecular Cloning

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		**Semester: 01**	
1	Course Code	MGE104	
2	Course Title	Molecular Cloning	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	(1) To understand the basic principles of cloning. (2) To learn about applications of PCR (3) To analyse different strategies of gene cloning (4) To elaborate different concepts of protein expression	
6	Course Outcomes	CO1:Inspect the ability of restriction endonucleases and other modification enzymes used in genetic engineering CO2:Analyze the difference between different vectors used in plants, bacteria and animal cells. CO3:Examine the gene amplification process using polymerase chain reaction. CO4:Elaborate the different types of cloning and expression vectors for genetic transformation. CO5:Discuss the genomic constructs and cDNA libraries. CO6:Analyze the different methods of molecular cloning and protein expression.	
7	Course Description	This course covers various enzymes used in Genetic manipulation, Cloning Vectors and expression vectors, PCR amplification, cDNA cloning and genomic libraries. It also gives conceptual idea about protein expression.	
8	Outline syllabus		CO Mapping
	Unit 1	**Enzymes and vectors used in gene cloning**	
	A	Restriction enzymes, DNA polymerases, reverse transcriptase, terminal transferase, alkaline phosphatase	CO1, CO6
	B	Polynucleotide kinase, ligase, DNases, RNases, and topoisomerase.	CO1, CO6
	C	Plasmid vectors, phage vectors, BAC vectors and plasmid incompatibility, and vectors for cloning in	CO1, CO6

		yeast, and mammalian cells	
	Unit 2	**Strategies of Gene cloning**	CO2, CO6
	A	Cohesive end cloning, blunt end cloning, checking the direction of cloning by PCR and restriction digestion,	CO2, CO6
	B	Cloning using adapters. TA cloning, TOPO-TA cloning	CO2, CO6
	C	Screening methods-complementation, insertional inactivation.	CO2, CO6
	Unit 3	**Polymerase chain reaction**	CO3, CO6
	A	PCR, factors affecting PCR, primer designing, Reverse transcriptase-PCR,	CO3, CO6
	B	Real-time PCR, Nested PCR and TaqMan probe, site directed mutagenesis by PCR,	CO3, CO6
	C	Screening by PCR, LAMP PCR.	CO3, CO6
	Unit 4	**cDNA and Genomic library**	CO4, CO6
	A	Construction of cDNA library, genomic DNA library	CO4, CO6
	B	Vectors used in the construction of cDNA and genomic DNA libraries	CO4, CO6
	C	Screening the libraries using heterologous probes, Reporter genes and assay.	CO4, CO6
	Unit 5	**Expression of proteins**	
	A	Components of an expression plasmid vector, strategies for codon optimization, optimization of induction of protein expression, inclusion body formation	CO5, CO6
	B	Factors affecting protein folding, solubilizing recombinant protein in inclusion bodies	CO5, CO6
	C	Purification of recombinant proteins with and without purification ligands.	CO5, CO6
	Mode of examination	**Theory**	
	Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
	Text book/s*	1.Griffiths JF (Ed.) (2010), *Introduction to Genetic Analysis*, W. H. Freeman, ISBN: 0716768879	
	Other References	1.Sambrook J, et al., (Eds.) (2000), *Molecular Cloning: a Laboratory Manual*, Cold Spring Harbor Laboratory Press, New York, ISBN: 978-1-936113-41-5	

MGE105 Advances in Immunology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester:1I	
1	Course Code	MGE105	
2	Course Title	Advances in Immunology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) This course is designed to impart the students the importance of immunology and its theoretical aspects and on the principles of immunology and Immuno technology. (2) It also explains the various antigen-antibody reactions involved in vaccine development.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Examine the deep foundation on host pathogen relationship for generation of immune response. CO2:Analyze the deep foundation of Immune response. CO3:Discuss the various functions of cells and organs of the immune system CO4:Elaborate how MHC recognizes self and non-self-molecules and helps in generation of immune response. CO5:Examine the genetic and molecular mechanisms associated with autoimmunity and graft rejection and review clinical interventions required in organ transplantation. CO6:Discuss on the immune system works and also on the immune system network and interactions during a disease or pathogen invasion.	
7	Course Description	This course will cover the major topics in cellular immunology, including antigen recognition, antigen processing and presentation to B and T cells, the events leading to the generation of antibody and T cell receptor diversity, antibody effector functions, the role of CD4 and CD8 T cell subsets and NK cells in immune responses, self-tolerance and autoimmunity, the inflammatory response and the role of immunity in protection against pathogens and cancer.	
8	Outline syllabus		CO Mapping
	Unit 1	**Microbes and parasites**	CO1, CO6
	A	Classification of pathogens-Bacteria, Fungi, Viruses, Protozoa, Helminths, Arthropods and Prions;	CO1
	B	Host-parasite relationship, modes of transmission, factors	CO1

		predisposing to microbial pathogenicity	
	C	stages, pathological patterns, virulence and infectivity	CO1, CO6
	Unit 2	**Humoral and cell mediated immunity**	CO2, CO6
	A	Cell mediated cytotoxicity: Mechanism of T cell and NK Cell mediated lysis, Antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity.	CO2
	B	Cytokines and their role in immune regulation,	CO2
	C	Biology of Complement system, Complement fixation test and assessment of immune complexes in tissues. Immune suppression and immune tolerance.	CO2, CO6
	Unit 3	**Cells of the immune system**	CO3, CO6
	A	Macrophages, B and T lymphocytes, Dendritic cells, Natural killer cells, Eosinophils, neutrophils and Mast cells.	CO3
	B	Organs of the immune system: Bone marrow, Spleen, lymph nodes, MALT.	CO3
	C	Haematopoiesis and differentiation, lymphocyte trafficking.	CO3, CO6
	Unit 4	**Antibody and Antigen**	CO4
	A	Antibody- biology, structure and functions in different classes of immunoglobulin. Antigens, Biology of superantigens.	CO4
	B	MHC structure and types, antigen recognition and presentation, activation of B and T lymphocytes.	CO4
	C	Design of different kinds of vaccines.	CO4, CO6
	Unit 5	**Hyper sensitivity reactions, Autoimmune disorders, Transplantation immunology**	CO5, CO6
	A	Hypersensitivities and their types	CO5
	B	Autoimmunity and autoimmune disorders	CO5
	C	MLR, HLA Typing, Bone marrow transplantation, Organ transplants.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
	Text book/s*	1.Goldsby RA (Ed.) (2006), Kuby Immunology, Freeman, ISBN: 9780716767640	
	Other References	1.Roitt, IM (Ed.) (1998), *Essentials of Immunology*, Blackwell Scientific publishers, London, ISBN: 978-1118415771	

MGE106 Metabolic Pathways

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: II	
1	Course Code	MGE106	
2	Course Title	Metabolic Pathways	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) Understand the overall organization of the biochemical metabolism. (2) Describe the structure and function of various biomolecules in maintaining balance in body.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Explain the basic metabolic pathways of carbohydrates CO2:Elaborate different types of lipids and their metabolism CO3:Discuss the metabolism of amino acids, and demonstrate how they are responsible for protein building. CO4:Elaborate nucleotide metabolism and synthesis of energy compounds. CO5:Examine the various mechanisms responsible for the generation of ATP in plants and animals. CO6:Inspect on metabolic pathways (catabolism and anabolism), their diversity and how these are specifically regulated and interrelated in different cells	
7	Course Description	The Biochemistry is designed to equip students with a broad understanding of the chemical and molecular events involved in biological processes. It helps students in understanding of structural and functional aspects of different biomolecules. The Biochemistry provides a foundation for careers in medicine, biotechnology, or research in all branches of the biological sciences.	
8	Outline syllabus		CO Mapping
	Unit 1	**Metabolism of carbohydrates**	CO1, CO6
	A	Photosynthesis, Biosynthesis of starch, glycogen and glucose,	CO1, CO6
	B	Glycolysis, TCA cycle, Gluconeogenesis, Pentose Phosphate pathway,	CO1, CO6
	C	Glycogen metabolism-Glycogenesis, glycogenolysis	CO1, CO6
	Unit 2	**Lipid Metabolism**	CO2, CO6
	A	Lipid profile, degradation and biosynthesis and	CO2, CO6

		regulation of fatty acids	
	B	Metabolism and regulation of membrane lipids, Ketone bodies.	CO2, CO6
	C	Metabolism, regulation and fate of cholesterol.	CO2, CO6
	Unit 3	**Amino acid and Protein metabolism**	CO3, CO6
	A	Digestion and absorption, Biosynthesis and degradation of amino acid.	CO3, CO6
	B	Metabolism and regulation of ammonia as well as urea cycle.	CO3, CO6
	C	Metabolic network-Interrelationship of metabolisms Krebs cycle, amino acid synthesis.	CO3, CO6
	Unit 4	**Metabolism of Nucleotides**	CO4, CO6
	A	Biosynthesis, degradation and regulation of nucleotides and related molecules.	CO4, CO6
	B	Energy compounds and its biosynthesis	CO4, CO6
	C	ATP, NAD, NADP, FAD, Creatin phosphates	CO4, CO6
	Unit 5	**Photophosphorylation and Oxidative phosphorylation**	CO5, CO6
	A	Redox reactions, standard oxidation reduction potential, mitochondrial electron transport chain,	CO5, CO6
	B	Oxidative phosphorylation, structure of ATP synthase, chemiosmotic hypothesis, coupled reaction, group transfer	CO5, CO6
	C	Biological energy transducers.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
	Text book/s*	1.Cox, Michael & Nelson, David (Eds) (2000), Lehninger *Principles of Biochemistry*. W.H. Freeman company New York 4th edition. ISBN: 978-1429234146	
	Other References	1.Voet D, Voet JG (Eds.) (2012), *Biochemistry*, Wiley New York, ISBN: 978-1-118-91840-1	

MGE109 Transgenic Organisms

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: II	
1	Course Code	MGE109	
2	Course Title	Transgenic Organisms	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) To learn *in vitro* regeneration, transformation, and gene editing of plants for the purpose of generating genetically modified plants for basic and applied research. (2) To learn *in vitro* techniques of animal cell and tissue culture for the purpose of generating genetically modified animals for basic and applied research. (3) To understand the mechanism of genetic engineering of microbes.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Explain *in vitro* regeneration of plants from different explants CO2:Discuss on the production of transgenic plants CO3:Elaborate the various culture techniques employed in animal systems. CO4:Acquire the knowledge about application of genetically modified animals in the various fields of science. CO5:Illustrate use of microbes and techniques for manipulation and analysis of microbial cells for the production of economically important products. CO6:Acquire the students to the versatile tools and techniques employed in genetic engineering and transgenic organisms.	
7	Course Description	The student will achieve a sound knowledge on methodological repertoire which allows them to innovatively apply these techniques in in basic and applied fields of life science researches related to transgenic organisms.	
8	Outline syllabus		CO Mapping
	Unit 1	**In Vitro Propagation of Plants**	CO1, CO6
	A	History of plant tissue culture, types of media and their preparation, plant hormones, direct and indirect organogenesis	CO1, CO6

	B	meristem, callus and suspension cell culture, micropropagation, somatic embryogenesis			CO1, CO6
	C	protoplast fusion, somaclonal variation, and artificial seeds			CO1, CO6
	Unit 2	**Transgenic Plants**			CO2, CO6
	A	Difference between transgenic plants and genetically edited plants. Transgenic crops for tolerance to abiotic stress, engineering crops for male sterility and modification of flower colour, flowering, fruit ripening and senescence.			CO2, CO6
	B	Modern approaches for disease resistance. Cloning plant genes, Comparative genomics positional cloning-RNAi-mediated crop improvement.			CO2, CO6
	C	Examples of transgenic Plants			CO2, CO6
	Unit 3	**Animal Cell Culture**			CO3, CO6
	A	Different types of cell culture media, growth supplements, serum free media, balanced salt solution, Conditions required for culturing animal cells,			CO3, CO6
	B	Behaviour of cells in culture conditions, division, their growth pattern, Estimation of cell number, Culture of mammalian cells, tissues and organs, primary culture, secondary culture,			CO3, CO6
	C	Continuous cell lines, suspension cultures and cryopreservation.			CO3, CO6
	Unit 4	**Applications of Animal Cell culture**			CO4, CO6
	A	Animal cell culture for in vitro testing of drugs, testing of toxicity of environmental pollutants in cell culture,			CO4, CO6
	B	cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins,			CO4, CO6
	C	Cloning of different animals, Cloning for conservation of endangered species.			CO4, CO6
	Unit 5	**Applications of Transgenic Microbes**			CO5, CO6
	A	Significance of transgenic microbes, Overexpression and tagging of recombinant proteins in *E. coli.* Overexpression systems in *S. cerevisiae*, Baculovirus overexpression system			CO5, CO6
	B	yeast one-hybrid assay, Yeast two hybrids system,			CO5, CO6
	C	Production of antibiotics, drugs, vitamins and therapeutic peptides using microbes.			CO5, CO6
	Mode of examination	Theory			
	Weightage	CA	MTE	ETE	

	Distribution	25%	25%	50%	
	Text book/s*	1.Primrose, SB, (Ed.) (1994), *Molecular Biotechnology*, Blackwell Scientific Publishers, Oxford, ISBN: 978-0632032334			
	Other References	1.Sambrook et al., (Eds.), (2000), *Molecular Cloning: a Laboratory Manual*, Cold Spring Harbor Laboratory Press, New York, ISBN: 9780879693091			

MGE201 Industrial Microbiology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGE201	
2	Course Title	Industrial Microbiology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) To enable students bridge the gap between theoretical concepts and practical aspects in industrial microbiology. (2) To have In-depth knowledge and hands-on laboratory/industrial skills required for employment or for creation of employment in desired product processing.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Discuss the design and functioning of bioreactors. CO2:Elaborate the Kinetics of fermentation process. CO3:Discuss the various steps and methods of recovery and purification of product. CO4:Discuss the methods and challenges for production of metabolites. CO5:Elucidate the various methods of production of enzymes, biofertilizers, SCP and recombinant proteins. CO6:Examine the various industrial application of Biotechnology.	
7	Course Description	The challenge for biochemical engineers is to design compact and clean processes to make and efficiently separate instable products, such as recombinant proteins, from dilute complex fermentation broths to the required pharmaceutical degree of purity. Therefore, the quantitative systematic design of integrated downstream processes is the general theme of this course and will help students in quantitatively and systematically design an integrated industrial process.	
8	Outline syllabus		CO Mapping
	Unit 1	**Bioreactor Design**	CO1, CO6
	A	Fermenter structure-Construction material, Basic components – Agitator, aerator, valves and steam traps, seals, stirrer glands.	CO1, CO6
	B	Measurement and control of parameters (on-line and off line sensors) – temperature, flow rate, pressure, pH, DO, gas analysis, computer control pathways.	CO1, CO6
	C	Types of Fermenters Air-lift, stirred tank, tower,	CO1, CO6

		fluidized bed, packed bed, pulsed, photo bioreactors, PFR.	
	Unit 2	**Kinetics of fermentation**	CO2, CO6
	A	Kinetics of Batch, fed-batch and continuous process;	CO2, CO6
	B	Sterilization methods - batch sterilization, continuous sterilization of medium and air. Solid state and submerged; aerobic and anaerobic fermentation.	CO2, CO6
	C	Development of inoculum for yeast, bacterial, mycelial and vegetative fungal processes. Transport phenomena - Mass transfer, heat transfer, oxygen transfer. Applications of fermentation technology	CO2, CO6
	Unit 3	**Downstream Processing**	CO3, CO6
	A	Biomass separation by centrifugation, filtration, flocculation and other recent developments	CO3, CO6
	B	Cell disintegration: Physical, chemical and enzymatic methods. Extraction: Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction.	CO3, CO6
	C	Purification by different methods. Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization	CO3, CO6
	Unit 4	**Production of primary and secondary metabolites**	CO4, CO6
	A	A brief outline of processes for the production of some commercially important primary metabolites	CO4, CO6
	B	Production of citric acid, lactic acid, acetic acid, glutamic acid, aspartic acid	CO4, CO6
	C	Production processes for various classes of secondary metabolites such as beta-lactams (penicillin, cephalosporin), aminoglycosides (streptomycin) macrolides (erythromycin)	CO4, CO6
	Unit 5	**Production of enzymes and other bioproducts**	CO5, CO6
	A	Production of industrial enzymes such as proteases, amylases, lipases	CO5, CO6
	B	Production of biopesticides, biofertilizers, Single cell protein	CO5, CO6
	C	Production of recombinant proteins with therapeutic and diagnostic applications	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
	Text book/s*	1.Stanbury et al., (Eds.) (2016), *Principles of Fermentation Technology*, Butterworth-Heinemann,	

		ISBN: 978-0080999531	
	Other References	1.Nielsen, et al., (Eds.) (2012), *Bioreaction Engineering Principles*, Plenum Press, ISBN: 9781461507673	

MGE202 Genomics and Proteomics

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGE202	
2	Course Title	Genomics and Proteomics	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	1. The aim of this course is to teach genomics, proteomics using model organisms representing plants and animals. The course will cover recent developments in genomics, gene expression and small RNAs. 2.The course imparts advanced knowledge on proteins through a detailed study of protein Structure, its characteristics property and significance in biological systems.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Discuss the various techniques and instrumentations used for nucleotide sequencing, genome sequencing and NGS CO2:Elaborate the concept of microarray, TILLING, and advances in genome analysis. CO3:Discuss the various steps and methods of protein purification and analysis. CO4:Discuss the methods and challenges for protein engineering. CO5:Examine the various applications of genomics and proteomics in human diseases, drug development and in food industry. CO6:Discuss on Genomics and Proteomics including fundamentals, current techniques and applications.	
7	Course Description	The objectives of this course include understanding the various aspects the diversity and complexity of eukaryotic genomes, the historical and evolutionary perspective of genomic content, techniques commonly employed in studies of genomics and transcriptomics and applications derived from the knowledge provided by this science.	
8	Outline syllabus		CO Mapping
	Unit 1	**Genome Sequencing**	CO1, CO6
	A	Overview of conventional and new sequencing technologies, Strategies used in whole genome sequencing, NGS technologies, RNAseq,	CO1, CO6
	B	Genome annotation, Candidate gene discover and data mining, Transcription factor, Genome mapping by	CO1, CO6

		genetic and physical technique.			
	C	Evolution and phylogenetic relationships of genomes in prokaryotes and eukaryotes.			CO1, CO6
	Unit 2	**Structural and Functional Genomics**			CO2, CO6
	A	Advances in research related to human genome, Arabidopsis genome, rice genome, wheat genome, Comparative genomics and SNP analysis.			CO2, CO6
	B	Microarray technology introduction, Types of DNA-microarrays- cDNAs and Oligonucleotides spotted chips.			CO2, CO6
	C	TILLING as a functional genomics tool. In silico genomics and metabolomics.			CO2, CO6
	Unit 3	**Scope of Proteomics**			CO3, CO6
	A	Introduction and scope of proteomics; Protein separation techniques: ion-exchange, size- exclusion and affinity chromatography techniques, SDA-PAGE, Isoelectric focusing (IEF), 2D PAGE for proteome analysis; Image analysis of 2D gels			CO3, CO6
	B	Protein chips and functional proteomics; Clinical and biomedical application of proteomics			CO3, CO6
	C	Proteome database; Proteomics industry.			CO3, CO6
	Unit 4	**Protein Engineering**			CO4, CO6
	A	Protein engineering methods, Rational design and site directed mutagenesis, directed mutation, Receptor-based QSAR methods, Phage display, cell free translation			CO4, CO6
	B	Protein scaffold, stability of enzymes, chemical modification of proteins, incorporation of unnatural amino acids into proteins,			CO4, CO6
	C	Use of ribosomal frameshift-suppressor tRNAs and editing-defective aminoacyl-tRNA synthetases, in vitro evolution of proteins			CO4, CO6
	Unit 5	**Applications of Genomics and Proteomics**			CO5, CO6
	A	Genomics of human diseases, nutritional genomics, epigenomics and methods of epigenomics			CO5, CO6
	B	Proteomics in bio-marker technology, Drug discovery,			CO5, CO6
	C	Proteomics in biopolymer industry and food industry.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Saraswathy, N and Ramalingam, P (Eds.) (2004), *Concepts and Techniques in Genomics and Proteomics*, Woodhead Publishing, ISBN: 978-1907568107			

	Other References	1.Twyman, R.M. (Ed.) (2004), *Principles of Proteomics*. Bios Scientific Publisher, Oxford, ISBN: 978-1859962732	

MGP105: Bioinformatics Lab

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: II	
1	Course Code	MGP105	
2	Course Title	Bioinformatics Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	To learn methods of Bioinformatics for understanding, determining and interpreting data of different structures of proteins and other molecules	
6	Course Outcomes	CO1: Discuss the basics and applications of Bioinformatics, CO2: Analyze the concepts of Protein characterization CO3: Acquire the knowledge of protein structure prediction CO4: Elaborate the various methods and applications towards Phylogenetic analysis and sequence alignment CO5: Examine the concepts of 3 D visualization of Protein structure CO6: Discuss the concept, branches, tools, and various applications for Bioinformatics	
7	Course Description	This course will cover the major areas in Bioinformatics namely sequence analysis, phylogenetic analysis, structure predictions, drug designing and discovery process.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Bioinformatics**	CO1, CO6
		Retrieval of Literatures from PubMed	CO1, CO6
		Retrieval of Protein sequence from UniProt,	CO1, CO6
	Unit 2	**Characterization of proteins**	CO2, CO6
		Physico chemical characterization of Proteins	CO2, CO6
		Detection of Phosphorylation and Glycosylation in Proteins	CO2, CO6
	Unit 3	**Protein Structure prediction**	CO3, CO6
		Secondary structure prediction of Proteins	CO3, CO6
		3D structure prediction	CO3, CO6
	Unit 4	**Sequence Alignment & Phylogenetic Analysis**	CO4, CO6
		Sequence Similarity Search- BLAST	CO4, CO6
		Phylogenetic Tree construction	CO4, CO6
	Unit 5	**3D structure Visualization**	CO5, CO6
		Protein structure visualization by PyMOL	CO5, CO6

		Secondary structure visualization by PyMOL			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE(VIVA)	ETE	
		25%	25%	50%	
	Text book/s*	1.Baxevanis A., Ouellette F.B.F (Eds.) (2004), *Bioinformatics: A practical guide to the analysis of genes and proteins*, Wiley-Interscience, ISBN: 978-0471478782			
	Other References	1.Jin X (Ed.) (2006), *Essential Bioinformatics*, Cambridge University Press, ISBN: 978-0521600828			

MGP201: Industrial Microbiology Lab

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGP201	
2	Course Title	Industrial Microbiology Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	To enable students, bridge the gap between theoretical concepts and practical aspects in industrial settings. In-depth knowledge of laboratory/industrial skills required for employment or for creation of employment in industrial microbiology area.	
6	Course Outcomes	CO1: Discuss the different sterilization methods. CO2: Prepare the stock solutions and bacterial growth culture media CO3: Examine the bacterial culture and growth curve analysis CO4: Discuss about Bioreactor/fermenter and Sauerkraut fermentation and CO5: Analyze the importance of industrially important bioactive compounds CO6: Develop the overall knowledge of industrial microbiology	
7	Course Description	The practical course provides a deeper basis of modern industrial microbiology.	
8	Outline syllabus		CO Mapping
	UNIT 1	**Introduction to sterilization techniques and media preparation**	CO1, CO6
		Different types of sterilization techniques	CO1, CO6
		Preparation of nutrient agar and nutrient broth media for cultivation of microorganisms.	CO1, CO6
	UNIT 2	**Isolation of microbes**	CO2, CO6
		Isolation of microorganisms from soil by serial dilution agar plating method	CO2, CO6
		To obtain pure culture of microorganisms by pour, spread and streak plate method.	CO2, CO6
	UNIT 3	**Growth curve and Sauerkraut fermentation**	CO3, CO6
		Growth curve analysis of isolated cultures	CO3, CO6
		To understand about Sauerkraut fermentation	CO3, CO6
	UNIT 4	**Cell disruption and Bioreactor**	CO4, CO6

		Cell Disruption Technique by Sonication			CO4, CO6
		To understand about components of Bioreactor/fermenter			CO4, CO6
	UNIT 5	**Enzyme production**			CO5, CO6
		Production of protease enzyme			CO5, CO6
		Production of amylase enzyme			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE(VIVA)	ETE	
		25%	25%	50%	
	Text book/s*	1. Josephine AM, Granato PA (Eds.) (2018), *Lab Manual and Workbook in Microbiology: Applications to Patient Care*, McGraw Hill, ISBN: 978-1260002188			

MGP202: Genomics and Proteomics Lab

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGP202	
2	Course Title	Genomics and Proteomics Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	(1) To perform the Extraction and isolation of DNA from plant leaves. (2) Visualization of isolated DNA on agarose gel electrophoresis. (3) Extraction of proteins from given plant sample. (4) Perform ion exchange chromatography. (5) To visualize isolated proteins on SDS-PAGE	
6	Course Outcomes	After finishing the course the students will be able to CO1: Analyze the Extraction and isolation of DNA from plant leaves. CO2: Discuss the importance of isolated DNA on agarose gel electrophoresis. CO3: Elaborate the protein extractions from given plant sample, using ammonium sulphate precipitation method. CO4: Examine the principle and applications ion exchange chromatography. CO5: Inspect the the protein visualization on SDS-PAGE. CO6: Discuss and understand the Extract and isolate DNA and proteins; run agarose and SDS-PAGE	
7	Course Description	To learn methods of extraction and isolation of DNA from given sample. Extraction and isolation of proteins from given plant sample using ammonium sulphate precipitation method. To run the SDS-PAGE, in order to visualize protein. To determine the concentration of proteins in given samples.	
8	Outline syllabus		CO Mapping
	Unit 1	**DNA Extraction**	CO1, CO6
		Perform the Extraction, quantification of DNA from given sample and visualization of isolated DNA on agarose gel electrophoresis	CO1, CO6
	Unit 2	**Protein Extraction**	CO2, CO6
		Extraction of proteins from given plant sample, using	CO2, CO6

		ammonium sulphate precipitation method.			
	Unit 3	Ion Exchange Chromatography			CO3, CO6
		Perform ion exchange chromatography for protein purification.			CO3, CO6
	Unit 4	**SDS-PAGE**			CO4, CO6
		Casting and running of SDS-PAGE for visualization of isolated proteins.			CO4, CO6
	Unit 5	**Protein Estimation**			CO5, CO6
		Determine the total protein content by Lowry or Bradford method.			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE(VIVA)	ETE	
		25%	25%	40%	
	Text/Practical book/s*	1.Benjamin FL, (Ed.), (2019), *Biochemistry in the Lab*, CRC Press, ISBN 9781138589964			

Syllabus of Skill Enhancement Courses

MGE 108 Bioinformatics

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: II	
1	Course Code	MGE108	
2	Course Title	Bioinformatics	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	(1) To understand the various biological databases and software tools. (2) Based on the available computational tools and databases, to solve the various biological problem	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Discuss the basics, branches, and various applications of Bioinformatics CO2:Analyze the importance, concepts and applications of various biological databases CO3:Examine the concepts, types, and uses of sequence alignment and explore the various methods and advantages for phylogenetic analysis CO4:Acquire the knowledge about structure predictions and their importance. CO5:Discuss the basics, types and various applications of computer aided drug designing and discovery process. CO6:Compile the overall understanding the concept, branches, tools, and various applications for Bioinformatics	
7	Course Description	This syllabus will cover the important areas in Bioinformatics namely sequence analysis, molecular phylogenetic analysis, structure predictions, computer aided drug designing and discovery process.	
8	Outline syllabus		CO Mapping
	Unit 1	**Basics of Bioinformatics**	CO1, CO6
	A	Introduction to Bioinformatics, Scope of Bioinformatics, Importance of Bioinformatics.	CO1, CO6
	B	Different branches of Bioinformatics, Applications of Bioinformatics	CO1, CO6
	C	PERL/Bio-PERL, Python/Bio-Python. Importance of	CO1, CO6

		Computers in Bioinformatics.			
	Unit 2	**Biological Databases**			CO2, CO6
	A	Introduction to Databases and Biological Databases, Primary Databases, Secondary Databases and Composite Databases.			CO2, CO6
	B	Nucleic acid sequence databases (GenBank, EMBL and DDBJ), Protein Sequence Databases (UniProt, PIR, TrEMBL, MIPS).			CO2, CO6
	C	Secondary Protein Sequence Databases (Prosite, PFAM, BLOCKS), Structural Databases: PubChem, Drug Bank, ZINC, PDB, PDBSUM. Sequence/structure Submission			CO2, CO6
	Unit 3	**Sequence alignment and Phylogenetic analysis**			CO3, CO6
	A	Sequence Identity, Sequence similarity, Pairwise Sequence alignment, Methods in Pair-wise sequence alignment (DOTPLOT, Dynamic Programming, BLAST & FASTA), Multiple sequence alignment,			CO3, CO6
	B	Methods in Multiple sequence alignment (Dynamic Programming, Progressive approach and Iterative Approach).			CO3, CO6
	C	Concepts of Phylogenetic analysis, Distance and Character based methods.			CO3, CO6
	Unit 4	**Structural Bioinformatics**			CO4, CO6
	A	Protein structures, Experimental methods for protein structure determination (X-ray Crystallography, Nuclear Magnetic Resonance and Cryo electron microscopy),			CO4, CO6
	B	In silico structure prediction methods: Homology modeling, Threading and Ab initio.			CO4, CO6
	C	Importance and limitation of in silico structure prediction methods. Visualization Tools.			CO4, CO6
	Unit 5	**Drug designing and discovery**			CO5, CO6
	A	History, Concept of Molecular docking, Structure Based Virtual Screening, Ligand Based Virtual Screening, Pharmacophore modeling,			CO5, CO6
	B	Quantitative Structure Activity Relationship (QSAR), Drug repurposing.			CO5, CO6
	C	Molecular docking tools, Concept and applications of Molecular dynamics Simulations.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Baxevanis A., Ouellette F.B.F, (Eds.) (2004),			

		Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley-Interscience, ISBN: 978-0471478782	
	Other References	1.Jin X (Ed.) (2006), *Essential Bioinformatics*, Cambridge University Press, ISBN: 978-0521600828	

Syllabus of Discipline Specific Elective Courses

MGE107 Techniques in Biology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: II	
1	Course Code	MGE107	
2	Course Title	Techniques in Biology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	(1) To develop and understanding of the principle, instrumentation, operation and applications of different analytical, separation (2) Diagnostic techniques used in the fields of Biochemistry, Molecular Biology and Biotechnology.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Apply microscopic techniques to identify differences between cells, cell organelles and intracellular localization of proteins. CO2:Apply chromatographic techniques for separating pigments, drugs, amino acids and hormones. CO3:Apply the spectroscopy techniques (Absorption and fluorescence, atomic and circular dichroism) to characterize physio-chemical properties of biological molecules. CO4:Elaborate various ways to study Ag-Ab interactions. CO5:Examine the various techniques to study various interactions of biomolecules at molecular level. CO6: Develop and understanding the applications of different analytical, separation techniques used in the field of Biotechnology.	
7	Course Description	Allow students to familiarize themselves with the specific requirements of biomedical instrumentation and biotechnology tools and to enable them to use and apply these techniques and equipment's to solve experimental problems.	
8	Outline syllabus		CO Mapping
	Unit 1	**Microscopic and Radiolabelling techniques**	CO1, CO6
	A	Visualization of cells and subcellular components by	CO1, CO6

		light microscopy, resolving power, microscopy of living cells,	
	B	scanning and transmission microscopes, different fixation and staining techniques for EM,	CO1, CO6
	C	Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material	CO1, CO6
	Unit 2	**Chromatographic techniques**	CO2, CO6
	A	Classification of Chromatography, Column and Ion-exchange chromatography	CO2, CO6
	B	Adsorption and Partition chromatography, Paper Chromatography, TLC, Liquid Chromatography, Gel permeation chromatography	CO2, CO6
	C	HPLC and GC	CO2, CO6
	Unit 3	**Biophysical Techniques**	CO3, CO6
	A	Molecular analysis using UV/visible, fluorescence, circular dichroism	CO3, CO6
	B	NMR and ESR spectroscopy	CO3, CO6
	C	Surface plasma resonance methods.	CO3, CO6
	Unit 4	**Histochemical and Immuno techniques**	CO4, CO6
	A	Antibody generation, Detection of molecules using ELISA, RIA, immunoprecipitation	CO4, CO6
	B	flowcytometry and immunofluorescence microscopy	CO4, CO6
	C	detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.	CO4, CO6
	Unit 5	**Techniques in Molecular Biology**	CO5, CO6
	A	Template challenge assay, Filter binding assay, Primer extension assay,	CO5, CO6
	B	DNA Helicase Assay, Biochemical Fractionation and Biochemical Complementation, DNA finger Printing	CO5, CO6
	C	SDS PAGE, 2D GE, western blot and Northern blotting	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
	Text book/s*	1.Wilson K. and Walker J, (Eds.) (2010), *Principles and Techniques of Biochemistry and Molecular Biology*, Cambridge University Press, ISBN: 978-1316614761	
	Other References	1.Ninfa AJ, Ballou DP and Benore M, (Eds.) (2009), Fundamental Laboratory Approaches for Biochemistry and Biotechnology, Wiley, ISBN: 978-0470087664	

MGE204 Clinical Biotechnology

School: SSET		Batch: 2023-25	
Programme: MSc		Current Academic Year: 2023-24	
Branch: Genetic Engineering		Semester: III	
1	Course Code	MGE204	
2	Course Title	Clinical Biotechnology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	(1) To acquire knowledge about the molecular pathology and pathogenesis. (2) To acquire knowledge about the diagnostic methods of infectious disease.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1:Categorize the various clinical aspects of infectious diseases. CO2:Examine the various factors involved in host pathogen relationship. CO3:Discuss the pathogenesis of various infectious diseases. CO4:Inspect the mode of actions of antibiotics, antimicrobial agents CO5:Discuss the different aspects and phases of clinical research. CO6:Discuss overall mechanism of infectious diseases and their treatment.	
7	Course Description	This course provides understanding of molecular pathology, host defense mechanism against pathogens, pathogenesis, virulence factors of pathogens, diagnostic methods and treatment of infectious diseases.	
8	Outline syllabus		CO Mapping
	Unit 1	**Clinical Aspects of Infectious Diseases**	CO1, CO6
	A	Bacterial, Viral and Parasitic diseases, Disease pathology and clinical spectrum, Clinical diagnosis of diseases;	CO1, CO6
	B	Molecular genetics of the host and the pathogen,	CO1, CO6
	C	Assays for the Diagnosis of bacterial, viral and parasitic diseases by using ELISA, RT-PCR and Western blot	CO1, CO6
	Unit 2	**Host Pathogen Interaction**	CO2, CO6
	A	Different reservoirs and epidemiology of pathogenic diseases, Different micro flora of skin, respiratory and excretory tract and other parts of body, Factors responsible for infection	CO2, CO6
	B	Colonization of pathogens inside body, Transmission via vector and without vectors,	CO2, CO6
	C	Toxins produced by pathogens, their types and their	CO2, CO6

		mode of action. Nosocomial infections.			
	Unit 3	**Pathogenesis of Infectious Diseases**			CO3, CO6
	A	Clinical features, diagnosis and treatment of Malaria, Leishmaniasis, Tetanus, Botulism			CO3, CO6
	B	Cholera, Plague, Tuberculosis, Measles, Mumps,			CO3, CO6
	C	HIV, HBV, Corona viruses, HPV, Dengue			CO3, CO6
	Unit 4	**Antimicrobial Agents**			CO4, CO6
	A	Antimicrobial drugs, antibiotics and their types,			CO4, CO6
	B	narrow spectrum and broad spectrum antibiotics, mode of action of antibiotics			CO4, CO6
	C	antiviral and antifungal agents. Antibiotic resistance			CO4, CO6
	Unit 5	**Clinical Research**			CO5, CO6
	A	Origin and history of drug development and clinical research			CO5, CO6
	B	types and phases of clinical research, clinical trials in India- the national perspective,			CO5, CO6
	C	ethical consideration and guidelines of clinical research, clinical trial management.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Pommerville JC (Ed) (2012), *Guide to Infectious Diseases by Body System*, Jones & Bartlett Learning, Second Edition, ISBN: 978-1449605919			
	Other References	1.Kasper D and Fauci A (Eds) (2017), *Harrison's Infectious Diseases* McGraw-Hill Education, Third Edition, ISBN: 978-1-259-83597-1			

MGE206 Plant Biotechnology

School: SSET		Batch: 2023-2025
Programme: M.Sc		Current Academic Year: 2023-2024
Branch: Genetic Engineering		Semester: 03
1	Course Code	MGE206
2	Course Title	Plant Biotechnology
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
5	Course Status	Elective
6	Course Objective	(1)The students are expected to understand the different techniques used in Plant Genetic Engineering like Agrobacterium-mediated gene delivery, direct gene transfer methods via PEG-mediated, electroporation, particle bombardment (2) To develop the knowledge and techniques for generating constructs for plant transformation and creating transgenic plants., (3)To set up appropriate conditions for regeneration of transgenic plants from genetically manipulated cells, clonal propagation of horticultural and forest species, etc. (4)To develop the knowledge of conservation of germplasm of endangered plant species and other important plants.
7	Course Outcomes	CO1: To comprehend the basic concept of plant genome engineering and Plant transformation. CO2:Gain knowledge on creating gene constructs for plant transformation and analyzing transgenic plants. CO3: To understand factors influencing transgene expression CO4: To learn about various approaches for gene editing and gene silencing in plants. CO5: To learn about various applications of transgenic plants. CO6: To learn about the versatile tools and techniques employed in genetic engineering and creating transgenic and genome edited plants.
8	Course Description	It helps students in understanding Plant genetic engineering – DNA delivery methods: vector mediated method, increase knowledge about Androgenesis and gynogenesisThegenetic engineering courseprovides a foundation for careers in plant GE.
9	Outline syllabus	CO

			Mapping
	Unit 1	**Introduction to Genetic Engineering in plants**	
	A	Overview of plant genome and genome engineering	CO1, CO6
	B	Transgenesis, Cisgenesis and intragenesis, Comparison with breeding	
	C	Plant transformation methods-direct and indirect. Transient and stable transformation, Vectors for plant transformation, Gateway vectors for plant transformation, superbinary and ternary vectors.	
	Unit 2	**Gene constructs and analysis of transgenic plants**	
	A	Designing gene constructs - Promoters (inducible, constitutive and tissue-specific) and heterologous promoters, polyAsignals; GAL4-UAS enhancer trapping approach,Protein targeting signals; Cre-Lox system for gene integration.	CO2, CO6
	B	Selectable and reportable markers, Marker free plants, Non-antibiotic based selection. Trait stacking in transgenic crops-challenges and opportunities.	
	C	DNA and copy number genotyping (PCR and Southern), RNA- and protein-based conformation (Real-time PCR, Northern, Western, ELISA).	
	Unit 3	**Factors influencing transgene expression level**	
	A	Transcription and translation related issues, PTGS. Co-suppression.Transgene stability	CO3, CO6
	B	Position effect and methods to overcome gene silencing and improve gene expression in transgenic plants	
	C	Promoters and other elements to express transgenes	
	Unit 4	**Gene Editing and silencing in plants**	
	A	Genome editing technology, CRISPR/Cas *etc*.	CO4, CO6
	B	Gene silencing using artificial miRNAs, RNAi technology, antisense RNA, lncRNA-based gene silencing	
	C	Random mutagenesis methods (T-DNA, EMS, transpososns), Transgenic versus genome edited plants	
	Unit 5	**Applications of Transgenic Plants**	
	A	Health benefits of transgenic plants. Improved seed storage proteins; Improving and altering the composition of starch and plant oils; enhancement of micro-nutrients – beta carotene, vitamin E, iron; Molecular pharming - production of antibodies and pharmaceuticals in plants	CO5 and CO6
	B	Agricultural applications of transgenic plants. Herbicide resistance; Pest resistance, Bt toxin, synthetic Bt toxin; Protease inhibitor; and other plant derived insecticidal genes;	

		nematode resistance; Crop Engineering for disease resistance; genetic improvement of abiotic stress tolerance, Genetic engineering for male sterility- Barnase-Barstar; Delayed fruit ripening; polygalacturanase, ACC synthase, ACC oxidase.			
	C	Bio-safety concerns of transgenic plants; Global status of transgenic plants, Regulation and approval of GM Plants.			
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Stewart C.N (Ed.) (2008), *Plant Biotechnology and Genetics: Techniques and Applications*, Wiley-Interscience, ISBN: 978-1118820124			
	Other References	1. Bernard R.G, Pasternak J.J (Eds.) (2002), *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, American Society for Microbiology, ISBN: 978-1555812249			

MGE110 Animal Biotechnology

School: SSET		Batch: 2023-2025	
Programme: M.Sc		Current Academic Year: 2023-2024	
Branch: Genetic Engineering		Semester: 02	
1	Course Code	MGE110	
2	Course Title	Animal Biotechnology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	To acquire a fundamental knowledge of animal cell culture, design and analysis of cell culture experiments; animal cell cloning, its applications and ethical issues.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: Explain set up of an animal cell culture facility including equipments and culture vessels required for animal cell culture CO2: Inspect media preparation and primary cell culture techniques CO3: Identify animal cell cloning procedures and risks associated with animal cell cloning CO4: Categorize different breeds of farm animals, their reproduction and improvement of livestock characteristics. CO5: Examine differentiation status of stem cells and compare properties of embryonic stem cells and adult stem cells. CO6: Justify the future perspectives, importance and ethical issues related with animal cell cloning and transgenic animals.	
7	Course Description	This course covers Animal cell culture, its molecular biology, recombinant DNA technology; Stem Cells, production of transgenic animals, reproductive biotechnology, biotechnology in animal breeding and ethics.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction and History of Animal Cell Culture**	
	A	Introduction to cell culture and history of Animal cell culture	CO1, CO6
	B	Biosafety levels and designing of animal cell culture laboratory	
	C	Important equipment and culture vessels required for animal	

		cell culture			
	Unit 2	**Development of Cell Culture**			
	A	Introduction to animal cell culture media and types; different cell culture reagents			CO2, CO6
	B	Primary and secondary cell culture; concept of finite and infinite cell lines, histotypic, organotypic and organ culture; 3D culture			
	C	Primary cell culture: methods to establish primary cell culture and its characteristics			
	Unit 3	**Maintenance of Cell Lines**			
	A	Thawing, Passaging and Cryopreservation of Cell Lines; Cell counting; assessment of cell viability and growth curve of cell lines			CO3, CO6
	B	Characterization of cell lines and common contaminants of cell line			
	C	Determination of cell viability using different cytotoxicity assays			
	Unit 4	**Animal Breeds: Reproduction and their Characterization**			
	A	Introduction to different breeds of farm animals; Cryopreservation of sperms and ova of livestock, artificial insemination			CO4, CO6
	B	Super ovulation, in vitro fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting and embryo sexing			
	C	Genetic characterization of live-stock breeds; Marker assisted breeding of livestock			
	Unit 5	**Scale up of Animal Cell Culture, Animal Cloning and Transgenic Animals**			
	A	Scale up of monolayer and suspension culture: Concept of fermenters in scale up of animal cell culture			CO5, CO6
	B	Animal Cloning: basics, cloning of different animals, cloning for conservation of endangered species			
	C	Transgenic manipulation of animal embryos, and applications of transgenic animals Ethical, social and moral issues related to cloning			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1.Butler M (Ed.) (2008), *Animal Cell Culture and Technology*, Garland Science, ISBN: 978-1859960493			

	Other References	1.Jenkins N (Ed.) (2006), *Animal Cell Biotechnology: Methods and Protocols*, Humana Press, ISBN: 0896035476 2. Freshney I.R (Ed.) (2005) *Culture of Animal Cells: A Manual of Basic Technique*, Wiley, 2005. ISBN: 978-1119513018	